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A long span steel cantilever bridge is to be built across the Ohio River at Cincinnati, O., according to recent reports. The bridge will be 1,000 ft. long and will have a main span of 850 ft. It will carry street railway tracks and roadways for wagons and pedestrians. R. W. Nelson, of Newport, Ky., is stated to be at the head of the company which has received the charter for the bridge.

The Senate has amended the House appropriation bill, which provided for the construction of a single armored cruiser, by adding provision for one battleship of 9,000 tons displacement, costing not over $4,000,000, exclusive of armament; one coast defense double turret vessel, 7,500 tons displacement, costing not over $3,000,000; four light draft gunboats, 800 to 1,200 tons, costing not over $450,000 each; and six torpedo boats, costing not over $110,000 each, no two of which shall be built by one establishment. For new breech mechanism plant for the Washington ordnance factory, $100,000 is added; and $83,000 for torpedo outfits for the "Boston," "Chicago" and "Atlanta." It is quite doubtful, however, whether the House will agree to any increase in the appropriations, as the provision for a single cruiser was only carried by a small majority.

The total amount of insurance on property in the United States, as shown by Extra Census Bulletin No. 17, has increased about 42 per cent. in the nine years, 1880-1889. The amount written and renewed in each year was as follows in millions of dollars:

	1880.	1889.	p. c. incr.
Fire insurance	7,833	11,725	49.8
Ocean marine insurance	1,631	1,936	20.3
Inland marine insurance	488	430	9.8
Tornado insurance	4	21	525.
Total	9,956	14,139	42.0

Whether the amount "written and renewed" means the total amount in force in each year, we do not know. We judge not, as there is an immense amount of insurance taken out for terms of years, and hence not requiring yearly renewal. The ratio of increase, at least, is a fairly accurate index of the increase in amount of property subject to destruction by fire.

The great Mexican main drainage tunnel, work on which has been for some time suspended because of difficulty with water, is to be pushed again. Matters have now been arranged with the Mexican government, and Messrs. Read & Campbell will continue the work on the tunnel under their own management, the government paying all expenses and buying new machinery. The water in the tunnel has been increasing so much that it was found impossible to arrange to continue the work on a fixed contract basis. Mr. Fred. W. Abbott is now Chief Engineer of the tunnel for Messrs. Read & Campbell. The water is still increasing in the several shafts, and new machinery and larger pumps are urgently required, but so far as the work is now in condition to be pushed, it is said to be progressing very favorably.

The British railway accident returns for the year 1891 show still fewer deaths but many more injuries from train accidents than in 1890, as follows:

	1891		1890	
	Killed.	Injured.	Killed.	Injured.
In train accidents only	17	1,029	30	645
All causes connected with moving vehicles	1,168	5,060	1,078	4,721

Only five passengers were killed by train accidents last year, we believe, the smallest number on record. We postpone any fuller review of the returns, which are in the usual very complete form, until they can be compared with the corresponding returns of the Interstate Commerce Commission for the year ending June 30, 1891.

A plate girder, 95 ft. 8½ ins. long and 9 ft. deep, was recently shipped by the Boston Bridge Works to Worcester, Mass., for a bridge to carry the New York, Providence & Boston R. R. over Southbridge St. There will be two of these girders, each weighing 57,715 lbs., and a solid floor of V-shaped steel troughs will be supported on the lower chords. The girder was loaded on three flat cars.

The cable driving engines for the power plant of the Broadway cable railway, New York, are being built by the Dickson Mfg. Co., of Scranton, Pa. At the Houston St. station will be four simple, non-condensing engines, with cylinders 38x60 ins.; and at the Fifty-first St. station two similar engines with cylinders 36x60 ins. The Corliss valve gear is used, and each engine has a 24-ft. flywheel, built up of nine segments, and weighing 100,000 lbs. The frame of each engine is one large, rectangular box casting, extending from the front cylinder head and including the main pillow block. The weight is about 34,500 lbs. The girders are formed in this frame, and have top and bottom slides of curved section, bored out from the end. The crosshead slides are curved to correspond. The crank pin is 11x11 ins., with a crank arm 11 ins. thick on a main shaft, 18 ins. diameter, the main bearings being 18x30 ins. The power of the engines, with an initial pressure of 150 lbs. and a speed of 60 revolutions per minute, is rated at 1,200 HP. for each of the larger and 1,000 HP. for each of the smaller engines.

The Chicago & South Side Elevated Railway (Eng. News, Jan. 16) will cross Michigan Boulevard by an ornamental structure of three spans, with a solid floor of iron buckle plates, covered with concrete.

Petroleum engines were described by Prof. W. C. Unwin in a recent paper before the Institution of Civil Engineers, England. He said that when the oil is introduced into the cylinder without the loss involved in working a gas-producer, the thermodynamic efficiency might be expected to be more than double that of a steam engine and boiler. This is the principle of the Priestman oil engine (Eng. News, Nov. 17, 1888), and particulars were given of the use of this engine for working rock drills, air compressors, etc., and driving launches and canal barges.

Electrical subways are to be laid at Duluth, Minn., a franchise having been granted to the Northern Electric Subway Co. for a term of 30 years.

The new shops for the New York Central R. R. at Depew, N. Y., will include two erecting shops, each 70x600 ft., with a capacity of 25 engines each; blacksmith shop, 80x252 ft.; machine shop, 80x360 ft.; boiler house, 36x80 ft.; boiler shop, 90x360 ft.; boiler iron and blacksmith shed, 20x360 ft.; pattern shop and store room, 50x144 ft.; casting storage shed, 50x150 ft.; offices and store house, 50x144 ft.; transfer table, 80x527 ft. The contract has been let to W. R. Haven.

The worst accident of the week was caused by the washing out of a trestle over a ravine near Revere, Mo., on the Atchison, Topeka & Santa Fe line, at 1:45 a. m., May 5, under circumstances detailed in full in another column. A terrific storm prevailed. The killed numbered 7 and the injured 32. A postal, baggage, smoking, chair, tourist sleeper and Pullman car went into the abyss. The engine on one side and the rear sleeper on the other side escaped.

A locomotive boiler explosion occurred May 4 at Irvona, Pa., on the Pennsylvania & Northwestern R. R., killing two men. The engine was standing in the yard.

A highway bridge over the railway tracks at Atwell's Ave., Providence, R. I., was damaged by a derailed freight car, May 1. It is an overhead highway bridge spanning six tracks, four belonging to the New York, Providence & Boston R. R., two to the New York & New England R. R. The bridge is supported by iron columns, and a car of a New York & New England freight train, in passing under the bridge, jumped the track and knocked down two of the columns, which caused one end of the bridge to settle and rest upon the cars. The bridge was soon jacked up to permit railway traffic to be resumed.

The Nicaragua canal is being brought to the attention of the far West by President Warner Miller. A public meeting in Minneapolis on April 28, addressed by him, was the first of a series which will be held in the principal cities of the Northwest, the Pacific coast and the Southwest.

The natural gas excitement at Salt Lake City is on the increase, and one or two new tracts have been staked off in city lots as a result of it. On April 28 gas was struck in a well just outside the city limits, and press reports state that "the roar of the escaping gas can be heard for half a mile."

The number of two-cylinder compound locomotives on the Worsdell and von Borries system increased from 1,034 to 1,358 during the year ending Nov. 1, 1891. In Russia alone the number was increased from 32 to 155.

The Connolly naphtha gas motor has recently been tried by the North Side Ry. Co., of Chicago, and two motors are being built for test. If these are successful it is said that they may be regularly used for night service.

The Whitehead torpedoes, 100 of which are being made for the Government by the E. W. Bliss Co., of Brooklyn, are soon to be tested. The torpedoes are 18 ins. in diameter, and carry a charge of about 250 lbs. of gun cotton.

The 3,000-ton protected cruiser "Cincinnati" under construction at the Brooklyn Navy Yard, is nearly ready for the launching, and her engines, which are being built in the Navy Yard shops, are nearly completed. The engines for the "Raleigh," a sister ship to the "Cincinnati," which was launched at Norfolk recently, have been shipped. The monitors "Puritan" and "Terror," and the "Maine" cannot be completed until the armor plate is received, which will not be for some months to come, as the armor plate contractors are concentrating their work on the "Monterey."

The latest reported aluminum producing company is the American Aluminum Co., of Philadelphia, which proposes to produce aluminum by a process devised by Edward C. Broadwell, at a cost of 35 cts. per lb. The inventor claims to be able to extract the impurities from clay and use it as his raw material.

Overhead wires are being put underground in Atlanta, Ga., and a system of electrical subways is under discussion in Wheeling, W. Va.

Street railways are to be built at Colombo, Ceylon, and proposals for their construction will be received until Sept. 30 by the Mayor, Mr. H. Hay Cameron.

The locomotive hauling the Empire State express from New York to Albany was tested by Mr. Angus Sinclair on May 3, and speeds as high as 78 miles an hour were recorded. Press reports state that the locomotive developed as high as 1,600 HP., and that the coal consumption was only 2¼ lbs. per HP. hour, which last is to be taken with some grains of allowance, as we recall only one other alleged performance (Wm. Stroudley's) where so low a coal consumption per HP. hour was realized. He claimed 2.04 lbs., but the claim has never been generally admitted. Mr. Sinclair's records will need to be very carefully digested before their exact indications can be given, anyway.

The spindles of textile machinery are run at enormously high rotative speeds; 8,000 revolutions per minute is often attained and even 10,000 and 12,000 are sometimes used. By the use of a recently invented ball bearing for spindles, it is claimed that speeds as high as 16,000 can be reached.

Three 15-year-old patent applications of Thos. A. Edison for telephone transmitters went to issue last week, after such long delay that the English patents, applied for after the American, had been examined, granted, gone to issue, run their term of 14 years, and expired, before the American patents were issued. It is a nice legal question whether these patents had not expired by limitation of law before they were issued. The courts will probably so hold. There is not so much ground for suspecting intentional and fraudulent delay in the interference proceedings, as there was with the Berliner patent, issued some months since, but they are as great a reproach to our patent practice and to the state of the law; and if upheld they will benefit the same Bell Telephone Co., by perpetuating their monopoly.

THE MEMPHIS BRIDGE.

The steel cantilever railway bridge recently completed across the Mississippi River at Memphis, Tenn., by the Kansas City & Memphis Railway & Bridge Co., was formally tested on May 12. The work of construction, which began in 1888, has been carried on so quietly that the structure has hardly received the attention, even from engineers, which its importance and magnitude demand, although its great length of span and depth of foundations place it well up among the largest bridges in the world. But aside from its engineering features its importance from a commercial standpoint is very great. It is the first bridge to be built across the Mississippi River below the mouth of the Ohio River, and its location is at the junction point of several of the most important of the southern railway systems both east and west of the river. The city of Memphis is entered by ten lines of railway; three from the west and seven from the east. These roads have heretofore been obliged to depend upon the slow and tedious operation of a transfer ferry for all interchange of traffic between the east and west sides of the river. While the bridge has been built principally in the interest of the allied companies, the Kansas City, Ft. Scott & Memphis and the Kansas City, Memphis & Birmingham, it will also serve the St. Louis, Iron Mountain & Southern and the Little Rock & Memphis railways, as well as the several lines entering the city from the east. Situated as it is on the line of great industrial and traffic development from Kansas City and the Southwest to the south Atlantic and Gulf coasts its importance is readily seen, and its chances as a paying enterprise seem good.

The construction of a bridge to replace the transfer at Memphis had been discussed for several years, but owing to the natural difficulties to be overcome and the great cost of such a structure nothing was done until 1885. During the winter of 1885 and 1886 an examination of the ground for the purpose of selecting a feasible site for the location of a bridge was made by Mr. Geo. S. Morison, M. Am. Soc. C. E., of Chicago, who afterward designed the bridge and superintended its erection. As a result of this investigation a charter for a bridge to be 75 ft. above high water, 22 ft. higher than is usually required, was secured at the next session of Congress. It was not until 1888, however, that the plans for the bridge were completed.

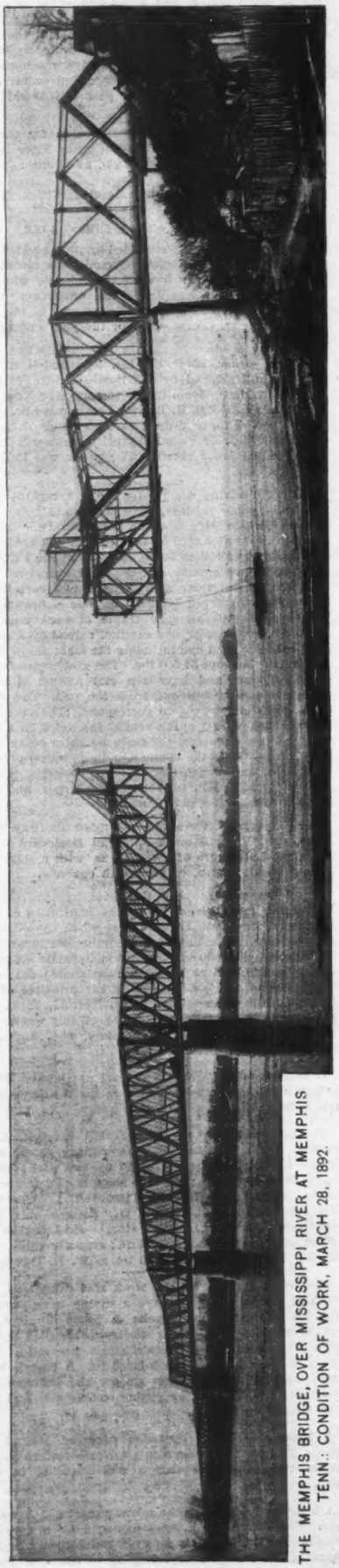
In brief, these plans called for a steel bridge across the river 2,597.12 ft. long, followed by an iron viaduct 2,290.6 ft. long and 3,097.5 ft. of timber trestle over the low swampy land on the west bank of the river, making the total length of the structure, including the eastern approach of 2,726 ft., a little over 2 miles. The bridge proper begins on the high bluff on the east side of the river known as the Chickasaw Bluff, and consists of five spans as follows:

	Feet.
Eastern shore span	225.83
Main span	790.42
Two river spans, each 621.06 ft.	1,242.12
Western shore span	338.75
Total length	2,597.12

The iron viaduct approach consists of 49 plate girder spans supported on Z-iron columns resting on small masonry piers on pile foundations.

From the west end of the trestle approach the bridge line is continued west by a high earth embankment to Sibley, Ark., where connection is made with the Kansas City, Ft. Scott & Memphis R. R. This embankment also crosses the St. Louis, Iron Mountain & Southern Ry., and the Little Rock & Memphis Ry., and has a connecting track to both roads. On the east or Tennessee side the bridge line connects with the Kansas City, Memphis & Birmingham R. R., by an approach consisting of three 23.8 ft. spans of iron viaduct and 2,641 ft. of trestle.

As the sinking of the caissons comprised the most important as well as the most difficult part of the work, the company decided to have the work done under the supervision of its own engineering staff, and accordingly headquarters were established at Memphis in the fall of 1888 and work commenced. The work was done under the immediate charge of the Resident Engineer, Mr. Alfred Noble, and under the supervision of the Chief Engineer, Mr. Geo. S. Morison. The accompanying profile shows the location of the several piers and the depths to which they were sunk. The caissons, which were five in number and unusually large, were sunk by the pneumatic process. Their dimensions were as follows:



THE MEMPHIS BRIDGE, OVER MISSISSIPPI RIVER AT MEMPHIS TENN.: CONDITION OF WORK, MARCH 28, 1892.

No. pier.	Length, feet.	Width, feet.	Height, feet.
1	70	50	51
2	92	47	60
3	92	47	40
4	60	26	30
5	40	22	80

Three of the caissons were built on the east shore of the river and then towed into position and sunk, and two were built on the sites of the piers. The timber used in their construction was yellow pine from southern Mississippi. The table (page 471) gives the elevations of the several parts of the completed foundations and the record of the progress of work.

As will be seen from the table the deepest foundation is 130.8 ft. below high water and the deepest immersion during building was 108 ft. This, with the exception of the eastern abutment of the Eads bridge at St. Louis, Mo., where the greatest immersion was 109.7 ft., is the greatest depth at which the pneumatic process has ever been worked. The air pressure carried at the greatest immersion was 47 lbs. per sq. in. At this pressure the men worked in shifts of 45 minutes, each man working three shifts in the 24 hours. At this point it is interesting to note that there were but four deaths from the caisson disease or "bends," a very favorable showing considering the depth and pressure at which the work was carried on. The depths of this foundation compared with the deepest foundation of the Eads bridge are shown in the following table:

	Below low water, feet.	Below high water, feet.	Greatest immersion, feet.
Memphis	96.2	130.8	108.
Eads, St. Louis	94.	135.5	109.7

The material penetrated consisted mainly of coarse sand and gravel to a depth of from 40 to 50 ft. with clay in some places. It was removed in the ordinary manner, by using the pressure of the compressed air to force the sand and mud out through the pipes for that purpose. The rate of sinking was limited by the progress made in building the masonry, and averaged about 2 ft. per day.

The river bed being of coarse sand and gravel at this point, its topography is, as at many other points along the river, subject to sudden and great changes from the action of the currents. To obviate as far as possible the disastrous effect of such changes upon the work a novel, and as far as we know an entirely new, expedient was used. Before each caisson was sunk a bed was prepared for it by sinking a willow mattress of the ordinary type used in the Mississippi River improvements by the government engineers. These mattresses were each 240 ft. wide and 400 ft. long, and were built from barges anchored over the pier sites, and sunk by being loaded with stone. The process of sinking the mattresses was as follows: When the weaving was completed, the mattress was loaded with stone until only a few points projected above the surface of the water. The barges carrying rock were then hauled across the upper edge of the mattress, stone being thrown from them so as to depress this edge below the surface of the water. To prevent the mattress from wholly sinking it was attached by lines to the mooring barges. After being placed in position the barges of stone were allowed to float slowly down over the mattresses, stone being thrown from them by a large force of men. When the upper half of the mattress had been sunk below the surface the lines connecting its upper edge with the mooring barges were cast off and this portion of the mattress sunk to the bottom. The upper edge of the mattress was attached to anchors a few hundred feet upstream.

The caissons were sunk on the carpets so prepared, the mattress and stone being cut through in the excavation. The object sought was to prevent the scour of the sandy bottom both during the sinking of the caissons and after completion of the masonry, and thus prevent the delay and possible disaster arising from any tilting of the caisson, and insure the stability of the completed pier. The success in sinking the caissons, which were unusually large, and the rapid progress of the foundation work is attributed largely to the use of these mattresses. In ad-

dition to preventing the scour of the river bed during the progress of the work the mattresses will be covered with riprap and will afford protection to the completed piers.

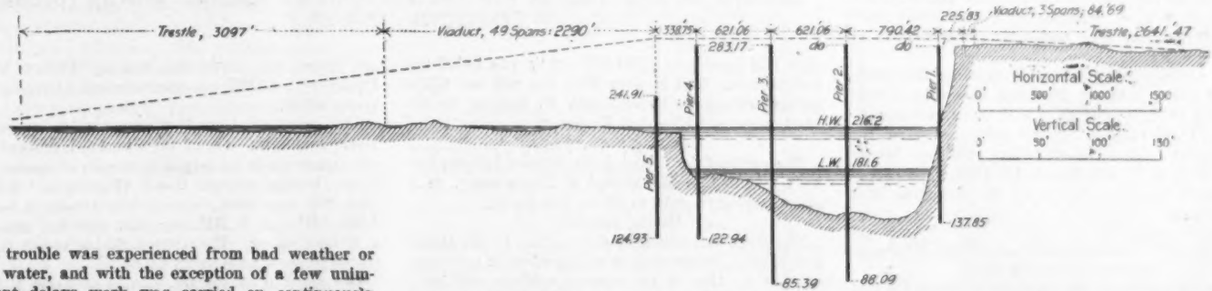
The five piers as well as the eastern abutment are of granite and limestone masonry. The facing is of granite from the quarries at Lithonia, Ga., and the backing is of Bedford, Ind., limestone. All masonry, including the backing, is of dimension stone. The contract for the masonry, including the east abutment, was let to L. Ross, of Rochester, N. Y. This east abutment is located on dry land and thus afforded few difficulties of construction as compared with the pier foundations. The bottom of its foundation is 50 ft. below the surface, and as it is an anchorage for the eastern cantilever span, it is of solid masonry and weighs 2,500 tons. The anchor rods pass entirely through the masonry and are connected at the bottom with a network of iron I-beams.

As will be seen by the table the last masonry was completed on pier 2 on April 25, 1891, 2 years and 5 months after the date of beginning the construction of the first caisson. During the entire work very little trouble was experienced from bad weather or high water, and with the exception of a few unimportant delays work was carried on continuously from the beginning.

	Pier 1.	Pier 2.	Pier 3.	Pier 4.	Pier 5.
Began building	Dec. 21, '89	May 17, '89	July 30, '89	Nov. 24, '88	April 25, '90
Launched	Built in place	July 29, '89	Oct. 26, '89	Dec. 15, '88	Built in place
Placed at pier site	Dec. 21, '89	Sept. 23, '89	Oct. 28, '89	Dec. 17, '88	April 25, '90
Began filling with concrete	Jan. 1, '90	Sept. 25, '89	Nov. 5, '89	Dec. 23, '88	May 8, '90
Building completed	Mar. 8, '90	Oct. 24, '89	Dec. 11, '89	Jan. 10, '89	May 27, '90
Filling completed	Mar. 9, '90	Oct. 11, '89	Nov. 27, '89	Jan. 10, '89	May 30, '90
Sinking commenced	Jan. 10, '90	Oct. 10, '89	Dec. 16, '89	Dec. 27, '88	May 8, '90
Sinking completed	Ap'l. 18, '90	Oct. 16, '90	Aug. 24, '90	Feb. 6, '89	June 8, '90
Sealing commenced	Ap'l. 18, '90	Oct. 16, '90	Aug. 18, '90	Feb. 6, '89	June 8, '90
Sealing completed	Ap'l. 22, '90	Oct. 24, '90	Sept. 4, '90	Feb. 10, '90	June 12, '90
Masonry commenced	Mar. 10, '90	Oct. 23, '89	Dec. 12, '89	Aug. 27, '89	No masonry. Cyls. May 28, '90.
Masonry completed	June 23, '90	Ap'l. 25, '91	Jan. 24, '91	Sept. 3, '90	Set coping. May 15, '91
Elevation cutting edge of caisson	137.85	88.09	85.39	122.94	124.93
Elevation top of caisson	190.69	147.29	125.01	173.38	204.93
Elevation top of masonry	283.17	283.17	283.17	283.17	241.91

Elevation of high water, 215.2. Elevation of low water, 181.6.

The first work on the superstructure began about Feb. 21, 1891, and consisted in placing the castings on pier 1. In July, 1891, the building of the false works for the center span began, and the erection of the iron work was commenced in September, 1891, and on Oct. 15 it was swung clear of the false works. The building of the false works for the span between piers 3 and 4, and the erection of that span followed next, and were completed in December, 1891. The deck span between piers 4 and 5 was completed in January, 1892, and work was then begun on the main span between piers 1 and 2 without false works. This span was swung on April 23, 1892.



PROFILE SHOWING LOCATION OF PIERS, ETC., MEMPHIS BRIDGE; Geo. S. Morison, Chief Engineer

Name.	Country.	Purpose.	Type.	Spans, feet.
Forth	Scotland	Double track railway	Cantilever	Two, 1,710 / Two, 690
Brooklyn	United States	Wagon and double track railway	Suspension	One, 1,595 / Two, 930
Cincinnati	" "	Wagon	"	One, 1,057
Fribourg	Switzerland		"	One, 870
Niagara	United States	Wagon and double track railway	"	One, 821
Sukkur	India	Double track railway	Cantilever	One, 820
Pittsburg	United States	Wagon	Suspension	One, 800
Memphis	" "	Single track railway	Cantilever	One, 790.4 / Two, 621
Red Rock	" "	" " "	"	One, 660
Louis I	Spain	Double deck wagon	Seg. arch	One, 566
Cincinnati	United States	Double track railway, wagon and street railway	Truss	One, 550 / Two, 490
Poughkeepsie	" "	Single track railway	Cantilever	Three, 548 / Two, 525
Ohio River	" "	Double track railway and wagon	Truss	One, 543 / Two, 486
Garabit	France	Single track railway	Seg. arch	One, 541
Douro	Portugal	" " "	"	One, 525
Merchants	United States	Double track railway	Truss	One, 524 / Two, 522
Henderson	" "	Single track railway	"	One, 522
Cairo	" "	" " "	"	Two, 520 / Seven, 408
St. Louis	" "	Double track railway and wagon	Seg. arch	One, 520 / Two, 502
Havre de Grace	" "	Single track railway	Truss	Two, 515 / Four, 476
Washington	" "	Wagon	Seg. arch	Two, 510

1 to pier 2, two cantilever arms each 169.38 ft., and an intermediate truss 451.66 ft.; pier 2 to pier 3, continuous truss 621.06 ft; pier 3 to pier 4, one cantilever arm 169.38 ft., and a parallel chord truss, 451.66 ft., with one end hung to the cantilever arm and the other supported on pier 4, and pier 4 to pier 5, one deck span, 338.75 ft. The longest span, from pier 1 to pier 2, is 790.42 ft. There are but two bridges in the world having longer trussed spans than this, and so far as we call to mind there are only seven bridges of any type in the world having longer spans. The following table shows the length of span of some of the more important bridges now existing as compared with the Memphis bridge.

The continuous superstructure is rigidly fastened to piers 1, 2 and 3, and rests on expansion rollers on pier 4. Slip joints provide for expansion at the suspended ends of the independent spans. The trusses are 30 ft. c. to c. and are divided into panels 28 ft. 2¾ ins. long. The trusses of the deck span are 22 ft. c. to c. The east end of this span is carried in nitches on pier 4, and the west end has roller bearings resting on pier 5. The estimated approximate weight of the continuous superstructure is 13,000,000 lbs., and that of the deck span 1,000,000 lbs., making the total estimated weight of the superstructure of the bridge proper 14,000,000 lbs., or 7,000 tons.

The steel of the bridge proper was furnished by the Union Bridge Co., of New York City, and A. P. Roberts & Co., of Philadelphia, Pa. The order to the Union Bridge Co. was given in January, 1890, and to A. P. Roberts & Co. in 1891. The general requirements are given in the following abstract from the specifications, which were very elaborate and complete:

All parts, except nuts, swivels, clevises and wall pedestal plates, will be of steel. The nuts, swivels, and clevises may be of wrought iron, but shall have sufficient strength to break the bodies of the members to which they are attached. The pedestal plates will be of cast iron.

The steel will be divided into three classes: (1) high grade steel, which will be used in all the principal truss members; (2) medium steel, which will be used in the floor system, laterals, portals, transverse bracing and the lacing of the truss members; (3) soft steel, which will be used only for rivets, and at the option of the contractor where wrought iron is permitted. The bolsters which carry the large pin bearings on piers 1, 2 and 3, will be of cast steel. In any case where it seems doubtful what quality of steel is required, high grade steel may be used.

Steel may be made by the open hearth or by the Bessemer process, but no steel shall be made at works which have not been in successful operation for at least one year. In the finished product of open-hearth steel the amount of phosphorus shall not average more than 0.08 of one per cent., and never exceed 0.1 of one per cent. In the Bessemer steel, the amount of phosphorus shall not average more than 0.04 of one per cent., and never exceed 0.05 of one per cent.

The laboratory test shall meet the following requirements:

	High't grade. Steel, lbs. per sq. in.	Medium Steel, lbs. per sq. in.	Soft Steel, lbs. per sq. in.
Max. ultimate strength	78,500	72,500	63,000
Min. ultimate strength	69,000	64,000	55,000
Min. elastic limit	40,000	37,000	30,000
	p. c.	p. c.	p. c.
Min. elongation in 8 ins.	18	22	28
Min. reduction of fracture	38	44	50

Steel for pins shall be sound and entirely free from piping and all pins in the main trusses shall be drilled through the axis.

The laboratory tests of the cast steel shall show an ultimate strength of at least 70,000 lbs., an elastic limit of at least 40,000 lbs., and an elongation of at least 15 per cent. in 8 ins. and a reduction of 18 per cent. at point of fracture.

All riveted members which are made of high-grade steel and all other pieces connecting with such members shall be solid drilled, no punching whatever being allowed, excepting lacing bars, which may be punched and reamed. Where bolts passing through the metal are used the holes shall be drilled in all metal more than ¾ in. thick, the diameter of the drilled hole to be at least ⅛ in. less than the diameter of the finished hole. In metal not more than ¾ in. thick punched holes may be used for fitting up, the diameter of the punched hole not to be more than three-quarters the diameter of the finished hole, and the number of punched holes never to exceed eight in any one plate or four in one flange of any one angle. After the drilling is completed a special reamer shall be run over both edges of every hole, so as to remove the sharp edges and make a fillet of at least 1-16 in. under each rivet head. In general, all holes which are to pass through several thicknesses of metal shall be drilled with all those pieces of metal assembled in the exact relative position they are to hold in the bridge. All rivets shall be driven by power wherever this is possible. Tightening by caliking or recupping will not be allowed. This applies to both power-driven and hand-driven rivets. All pin holes and holes for turned bolts passing through the whole width of a riveted member shall be bored or drilled after all other work is completed. All riveted members which are composed entirely of medium steel may be punched and reamed; but this

does not apply to the connections between such members and high grade steel members, which connections shall be solid drilled throughout.

The heads of eye-bars shall be formed by upsetting and forging. No welds will be allowed. After the working is completed the bars shall be annealed in a suitable annealing furnace by heating them to a uniform dark red heat and allowing them to cool slowly. The thickness of the head shall not be more than 1-16 in. greater than that of the body of the bar, and the heads shall be of sufficient strength to break the body of the bar. Nuts, swivels and clevises, if made of steel shall be forged without welds, and whether made of steel or wrought iron, one of each size shall be tested and be of sufficient strength to break the bars to which they are attached. Twenty full-sized steel eye-bars shall be selected from time to time from the bars made for the bridge by the inspector for testing.

The tests of full-sized eye-bars shall be made in the large testing machine at Athens. These bars will be required to develop an average stretch of 12 per cent. and a minimum stretch of 10 per cent. before breaking. The elongation shall be measured on a length of not less than 20 ft., including the fracture. The bars will be required to break in the body. They shall also show an elastic limit of not less than 32,000 lbs. and an ultimate strength of not less than 62,000 lbs., as indicated by the registering gages of the testing machine at Athens. In the case of bars too long for the machine, the bars shall be cut in two, each half reheaded, and both halves tested in the machine, the two tests, however, to count as a single test bar. If the capacity of the machine (estimated at 1,200,000 lbs.) is reached before the bar is broken, the bar shall be taken out of the machine and the edges shall be planed off for a length of 10 ft. at the center until the section is reduced to the equivalent of 16 sq. in. of section of the original bar. The bar shall then be placed in the machine and broken; when this is done, the elongation shall be measured on a length of 8 ft. and an ultimate strength of 60,000 lbs. computed on the 16 in. of original section will be considered satisfactory.

The contracts for furnishing the metal for the 2,300 ft. of the viaduct approach on the west side of the river were given to the Pennsylvania Steel Co., of Steelton, Pa., and Cofrode & Saylor, of Pottstown, Pa.

The accompanying engraving showing the condition of work on March 28, 1892, also gives a very fair idea of the bridge as it will appear when completed. Partial views of the bridge showing the progress of work have also been published in our issues of Feb. 27 and March 12, 1892. We expect to publish complete details of the structure in a future issue.

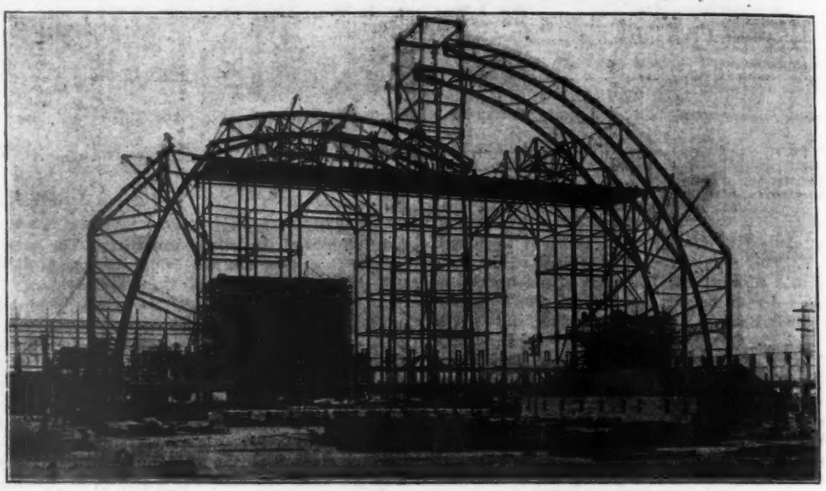
WORLD'S COLUMBIAN EXPOSITION.

Manufactures Building.

Some particulars of the great arch trusses for this building, and the method of erecting them, were given in our issue of April 21. From Mr. John Worcester, who is superintendent of the erection for the Exposition management, we have received the view of the work which we reproduce herewith, together with the following notes of progress. The first pair of arches was erected in 11½ days, the average number of men being 147. The total weight was 640,000 lbs., an average of 380 lbs. per man per day. The traveler was moved 100 ft. in three hours. The second pair of arches was erected in nine days, with an average of 148 men. The total weight was 694,000 lbs., the difference from the weight of the first pair being in the number of purlins set, and the average weight per man per day was 520 lbs. The second move of the traveler for 100 ft. was made in 45 minutes, and the third pair of arches was up to the traveler platform by April 30. The method of erection was designed by Mr. S. Mitchell, Assistant Manager of the Edge Moor Bridge Works, and in a later issue we shall give further details of the building and its erection.

Boiler Plant.

In our issues of March 5 and April 9 we have given particulars of the boiler plant and the fuel for power purposes. The fuel is to be oil, and the contract has been awarded to the Standard Oil Co., as already noted. The contracts for boilers have been distributed among six firms and are all for water-tube boilers. The successful bidders and the amount of power each will furnish are as follows: Heine Safety Boiler Co., St. Louis, Mo., boilers to have a capacity of evaporating 112,500 lbs. of water per hour; Campbell & Zell Co., Baltimore, Md., 112,500 lbs.; Mills Patent Sectional Boiler Co., Manchester, England, 90,000 lbs.; Stearns Mfg. Co., Erie, Pa., 45,000 lbs.; Abendroth & Root Mfg. Co., New York, 45,000 lbs., and the National Water Tube Boiler Co., New York, 45,000 lbs. The kinds of burners, injectors and other appliances for the use of oil fuel are left to the selection of the boiler makers, but none of the makers are yet prepared to give information on this point. The Heine Safety Boiler Co. states that it will put in eight Heine boilers, rated at 375 HP. each. The company has now in use in this country about 1,000 boilers aggregating 325,000 HP. The Campbell & Zell Co. states that the number of boilers has not been determined, but that they will aggregate 2,500 HP.; they will be of the Zell pattern. The Stearns Mfg. Co. will use Gill's patent water-tube boilers. Mr. F. Sargent is the Mechanical and Electrical Engineer.



ERECTION OF ARCH TRUSSES FOR THE MANUFACTURES BUILDING, WORLD'S COLUMBIAN EXPOSITION; SPAN, 328 FT.

Dredging the Lagoons.

The contract for dredging the interior lagoons has been awarded to MacMahon & Montgomery, at a price varying from 10 to 18 cts. per cu. yd.

Mining Exhibits.

The scope and extent of the exhibits in the Mines and Mining Department were described in our issue of May 5. One of the notable exhibits will be a model of the entire plant of the H. C. Frick Coke Co., of Scottdale, Pa. The company has a capital of about $40,000,000, and is said to be the largest of its kind in the world. The model will cost between $3,000 and $4,000, and the contract for making it has been awarded to the Jones Bros. Electric Co., of Cincinnati, O. It will be on a scale of 1-20 of an inch to the foot, covering a space of about 20x50 ft., and will be an exact representation of the works, including engines, boilers, piping, elevated tracks, hoists, cupolas, ovens, cars and all other machinery. The machinery will be in operation, the motive power being electricity, with gas for the ovens, the coke therein being represented by asbestos. The model will represent a section of one of the shafts, extending from the floor to the top of the stand, with tipple, self-acting rams, bins, cages, winding apparatus, engine and boiler houses with their machinery, workshop and electric light plant. There will also be shown several tenement houses and a block of ovens with the charging engines, lorries, railway tracks, etc. The company will also exhibit samples of its products, and a topographical chart of the Connellsville district, showing the location of the company's property and plants.

TORPEDO VESSEL FOR THE U. S. NAVY.

(With inset.)

Upon our inset sheet this week we show the designs made by the Bureau of Steam Engineering for the machinery of a vessel which, with but 750 tons displacement, is intended to carry engines developing 6,000 I. HP., or 8 HP. per ton.

Chief Engineer Geo. W. Melville, in his report, says that so far as is known this is the greatest power ever proposed for this displacement. While this is quite true, vessels of smaller displacement have been built with even a larger power in proportion to size. Torpedo boats are especially noted for their combination of high power with small speed. The "Cushing" in some high speed tests last year showed 1,336 I. HP. with 125 tons displacement, or 10.7 HP. per ton. A Spanish seagoing torpedo vessel, the "Destructor," built in 1886 by Thompson, of England, showed 3,829 I. HP. with a displacement of 385 tons, or a little less than 70 HP. per ton. Her average speed on a 3-hour trial was 22.6 knots per hour, and a maximum of 23¾ knots was reached. The vessel has proven herself thoroughly seaworthy, and in "Recent Naval Progress" for 1887 was characterized as the fastest vessel afloat.

The proposed United States torpedo vessel is about double the size of the Spanish boat, and the only approach to her power in vessels of similar size is the Italian torpedo vessel "Partenope," which, with 859 tons displacement, has developed nearly 4,300 HP., or 5 HP. per ton, and has attained a 20-knot speed. The United States vessel is expected to show at least 23 knots.

The problem of placing engines of 6,000 I. HP. in a hull only 25 ft. wide on the water line at the engine rooms was no easy one, and the drawing of the general arrangement of machinery shows how every available bit of space between the bunkers has been utilized by the designer. Triple expansion engines were adopted, but space has been saved by the use of two low pressure cylinders instead of one. The following description of the machinery is given in the official report of Chief Engineer Geo. W. Melville:

There are twin-screw, triple-expansion engines of the vertical, inverted cylinder, direct acting type for the main engines, fitted as rights and lefts and in a common compartment. There is one high pressure cylinder 23¾ ins. diameter, one intermediate, 34¼ ins. diameter, and two low pressure, each 38 ins. diameter, the common stroke being 18 ins. The working steam pressure is 200 lbs., and the revolutions of the propelling engines 333 per minute, giving a piston speed of 1,000 ft. per minute. The main valves are all of the piston type, one for the high pressure, two for the intermediate, and two for each low pressure cylinder, all worked from Stephenson double bar links. The valves for the high pressure and intermediate cylinders are each a single casting turned to a neat fit and without packing rings; the low pressure valves are fitted with packing rings and followers. The point of cut-off, in full gear, is at 7-10 of the stroke. The engine framing consists of forged steel columns, trussed by forged steel stays. The bed plates are of cast steel, supported on plate steel keelsons built in the vessel. The crank shafts form a single hollow forging.

There is only one condenser for both engines, of composition and rolled brass. The cooling surface is 8,400 sq. ft. There are four vertical single acting air pumps; two worked from the low pressure cross-heads of each engine; the diameter is 19 ins. and the stroke 6 ins. There are two centrifugal circulating pumps, each driven by an independent single cylinder engine; each

pump is to have a capacity of 6,000 gallons per minute.

The type and dimensions of boilers were to be selected by the contractor, with the approval of the Navy Department, but were to be coil, sectional, or tubular. The requirements were: "Efficient means must be provided for getting at the interior of such parts of the boilers as require attention for examination, cleaning, and repair, and the tubes must be so arranged as to be readily removed, replaced, and expanded in case of leaks. All parts of the boilers must be readily accessible for cleaning and painting." Provision is made for adequate feed pumps and a feed water heater.

The specifications include steam reversing gear, ash hoists, ventilating fans, evaporators, distillers, and auxiliary pumps. The weight of all machinery, boilers, auxiliaries, tools, and spare parts, including contained water, was not to exceed 255 tons. 85 lbs. per I. HP.

The construction of this vessel was authorized by the naval appropriation bill for the fiscal year ending June 30, 1891, which called for the construction of "one swift torpedo cruiser of about 750 tons displacement at a cost, exclusive of armament, not to exceed $350,000, to have a maximum speed of not less than 23 knots." Proposals were advertised for, but as none were received the construction of the vessel has been postponed for the present.

The purpose of this vessel may be appreciated by reference to the summary of the present status of our navy in our issue of Dec. 12, 1891. It was there shown that other naval powers of the world have fleets of torpedo boats ranging in number from France's 215 to Spain's 15. The United States has one single torpedo boat; and in any operation of her naval vessels against an enemy she would run great risk of losing some of her enormously expensive battle ships and cruisers through the activity of some of the opposing fleet's torpedo boats.

As a means of defense against these the torpedo vessel and torpedo cruiser have been evolved, and all the principal naval powers have several vessels of this type. In naval circles a distinction is made between the torpedo cruiser and torpedo vessel, the latter term being restricted to vessels between 300 and 1,000 tons, smaller vessels being termed torpedo boats, and larger ones, built for a similar duty, torpedo cruisers.

As described by Lieut. Ridgely Hunt in the Annual of the Office of Naval Intelligence, the torpedo vessel should be as small as possible to minimize the risk of being struck by the heavy shot from hostile cruisers and armored vessels. At the same time she should be large enough to go to sea and to mount an efficient battery of rapid fire and machine guns heavy enough to penetrate the hulls of attacking torpedo boats. It is equally important that she should have high speed to overhaul and capture the swiftest torpedo boats, and also escape from close quarters with ships of heavy armament. Light draft is a great advantage, since torpedo boats operate almost invariably on the coast, and will seek to escape in shallow estuaries.

Several attempts were made to construct vessels of this type in the years between 1876 and 1882 by different European nations, but failure was invariably made with respect to speed, only 12 to 14 knots being reached. In 1882 Germany launched two vessels belonging more properly to the torpedo cruiser type, having a displacement of 1,380 tons. The speed attained was about 18 knots. [illegible] present time the best torpedo vessels in use by the principal nations are about as follows:

Nation	Vessel or class.	Displacement. tons.	I. HP. total.	Sp'd, p'r t'n.	Sp'd, k'ts.
France	"Bombe" class.....	295	1,800	4.55	19.
Spain	"Destructor".....	350	3,850	10.95	22.6
England	"Rattlesnake" class.	550	2,800	5.20	19.5
England	"Sharpshooter" class.	850	3,500	4.12	19.5
Italy	"Partenope"	859	4,300	5.00	20.

Germany is now turning out some vessels of 300 to 450 tons displacement which have made 21 to 23 knots on trial trips, and those now building are expected to make 26 knots.

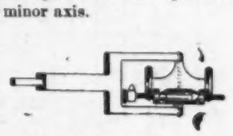
It will be seen from the above that with the exception of Germany's new vessels now building, the proposed vessel whose machinery we illustrate would be about the swiftest sea-going naval vessel in existence.

Apart from the question of national defense, the results from the use of such high steam pressure and high piston speed as is here proposed would be of such interest and value to mechanical engineers that it is to be hoped that the construction of the vessel may soon go forward.

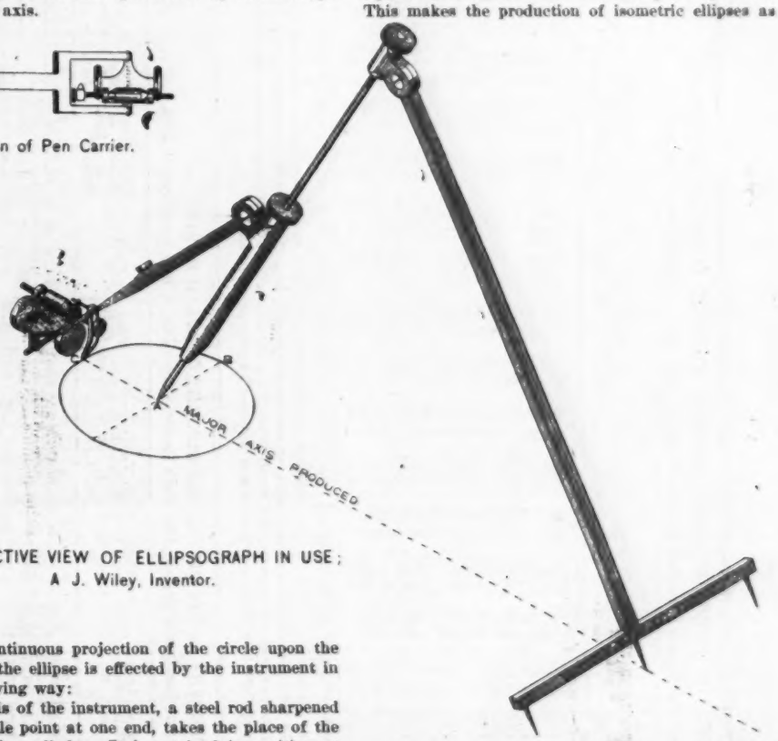
A COMPASS FOR DESCRIBING ELLIPSES.

By A. J. Wiley.

The instrument for describing ellipses shown in the accompanying drawing is constructed upon the theorem that any given ellipse may be produced by the intersection of a cylinder by a plane, or by the projection of the circle of the cylinder upon the plane by lines parallel to its axis. The minor axis of the ellipse will equal the diameter of the cylinder, and the major axis will be the projection of the diameter upon the inclined plane which passes through the minor axis.



Plan of Pen Carrier.



PERSPECTIVE VIEW OF ELLIPSOGRAPH IN USE; A. J. Wiley, Inventor.

The continuous projection of the circle upon the plane of the ellipse is effected by the instrument in the following way:

The axis of the instrument, a steel rod sharpened to a needle point at one end, takes the place of the axis of the cylinder. It is retained in position at any angle with the plane of the ellipse by a T-shaped arm hinged to a threaded sleeve upon the upper end of the axis. A sleeve carrying a hinged arm, to the lower end of which is attached the generating point, moves freely upon the axis of the instrument.

If it is required to draw an ellipse, having given its two axes, the needle point of the axis of the instrument is placed on the center of the ellipse. Then, with the needle point of the supporting arm on the major axis produced, set the generating point to the semi-minor axis, and give the axis of the instrument, by means of its supporting arm, such an inclination that the generating point will touch the extremity of the major axis. The axis of the instrument now coincides with the axis of the intersected cylinder, and the plane of the drawing represents the intersecting plane. The ellipse is described by revolving the sleeve carrying the generating point while the point is kept in contact with the surface of the drawing. The ellipse may be drawn directly from the intersected cylinder by setting the generating point to the radius of the cylinder and making the angle between the axis of the instrument and the major axis of the ellipse equal to the inclination of the intersecting plane.

To produce the ellipse in pencil the ordinary pencil point of the dividers may be used, but to describe it in ink it is necessary that the pen point should move in a plane perpendicular to the paper. This is effected by attaching the pen to a truck, hinged to the generating arm, and carried by two wheels. The pen is pressed lightly against the paper by a spring, and is attached to a slow motion screw for close setting after the approximate setting is made by the generating arm. Close setting for inclination of the axis may also be made by revolving the axis in the threaded sleeve to which is hinged the supporting arm.

The instrument has the same capacity for ellipses that the ordinary dividers have for circles, and may be extended, like the dividers, by the use of a lengthening bar. It is especially adapted for the production of very small ellipses, the revolution of the generating point about a stationary axis being the most perfect method for describing minute circles, and answering equally well for small ellipses.

In isometric drawing, where all circles in the isometric planes become ellipses of the same eccentricity, the inclination of the axis of the instrument is always the same, and it is only necessary to set the generating point to the semi-minor axis, which equals the isometric diameter multiplied by 0.707. This makes the production of isometric ellipses as rapid and accurate as the drawing of circles with the dividers, and should render more popular this very valuable system of drawing.

THE ENGINEERING SCHOOLS OF THE UNITED STATES.

Owing to the great demands upon our space in this issue, the continuation of this series of articles is postponed until our next issue.

A new railway route to London from the north has been authorized by the passage of a bill permitting the Manchester, Sheffield & Lincolnshire Ry. Co. to build a line 112 miles long from Annesley, near Sheffield, on the company's system, to a junction with the Aylesbury & Buckingham extension of the Metropolitan Ry., of London. The scheme includes a large terminal station in London, and as the president of the Manchester, Sheffield & Lincolnshire Ry. Co. is also president of the Metropolitan Ry. and Southeastern Ry. companies, one result of the construction of the new line will probably be a through service between the northern and southern railway systems.

The uniformity of railway gage in the United States is the subject of a short paper by M. H. Rousseau, engineer of the Ponts et Chaussees, recently published in the "Annales des Ponts et Chaussees," France. The author refers to the change of the southern gage of 5 ft. to standard gage, on May 31 and June 1, 1886, involving 13,000 miles of main track, 1,500 miles of side track, 1,800 locomotives and 45,000 cars, and costing about $1,300,000. He gives the following table of the comparative mileage of gages in 1880 and 1889, summarized from the table in the Interstate Commerce Commission statistics for 1889:

Gage.	1880. Miles.	1880. Per cent.	1889. Miles.	1889. Per cent.
4 ft. 8½ ins.....	86,476	80.2	147,001	93.4
3 ft.....	5,223	4.8	9,571	6.1
Various.....	16,131	15.0	835	0.5
Total.....	107,829	100.0	157,407	100.0

An earthquake occurred in California, April 19. A comparatively small district, north of San Francisco, was affected, and a number of buildings were wrecked and damaged, but nobody was killed. The shocks are said to have lasted for nearly a minute.

RELATIVE FREQUENCY OF BREAKAGES IN DIFFERENT PARTS OF WROUGHT IRON JANNEY FREIGHT COUPLER KNUCKLES.

As Determined by Percentage Computations from the Total Number of Breakages, Reported by Each Railway, from Jan. 1, 1886, to March 31, 1892.

	Fig No.	General Average.	All'y Vall.	Balt. & Ohio.	Ch'go, Burl. & Q.	C., C., & St. L.	Canda Cattle Car Co.	Ch'go, Milw. & St. P.	Ch'go & N. W.	Ch'go, R. I. & Pac.	Ches. & Ohio.	Gr'd Rap. & Ind.	Lake Shore & M. S.	Le'gh Vall.	Mich. Cent.	Nor'n Cent.	N. Y. Cent. & H. R.	N. Y., Chi. & St. L.	N. Y., L. E. & West.	Nor'n Pacific.	Penn. R. R.	Pa. Co. N. W.	Pa. Co. S. W.	Phila. Wil. & Balt.	Rich. & Danv.	Rome, Wat. & Ogd'g	Union Pacif.	West Shore.	West. N. Y. & Penn.	Wisc. Cent.	Misc.
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Upper lug off	1	27.59	13.15	16.53	27.85	21.09	14.59	36.78	30.78	27.40	19.63	42.65	17.30	24.28	22.01	42.86	11.49	12.21	29.13	33.02	38.56	32.91	39.25	38.23	21.43	17.10	38.67	19.18	13.92	37.23	27.28
Upper lug cracked	2	19 08	27.61	15.70	7.57	19.83	20.84	8.23	9.48	8.42	17.58	8.83	33.01	34.15	16.21	21.43	33.41	35.08	18.87	7.31	13.58	21.89	10.27	11.23	17.51	11.84	9 34	17.12	29 24	9.58	22.69
Upper lug chipped	3	19 86	29.82	31.40	9.75	28.76	43.75	16.12	21 09	23.88	13.93	13.23	21.34	18.48	36.68	14.29	25.30	23.65	19.36	23.35	15.89	17 89	17.01	21.67	31.93	28 94	6.67	24.65	28.24	8.51	18.55
Lower lug off	4	5.29	3.76	5.79	7.59	4.85	2.08	13.52	11.18	6.01	2.74	8.83	3.70	5.98	5.79	5.46	4.63	2.13	5.75	3.78	4.29	3.83	4.99	5.22	3.77	10 52	6.67	7.53	3.22	9.58	6.51
Lower lug cracked	5	2.90	5.34	4 13	1.35	2.24	1.04	2.35	2.13	1.76	1.60	2.94	4.76	3.80	2.32	0.84	4.95	6.20	3.02	0.71	1.54	2.64	1.41	1.87	2.26	3 15	1.33	2.74	7.66	.....	4.24
Lower lug chipped	6	2.13	4.82	3.31	1.51	2.23	2.08	2.31	2.77	2.61	1.60	4.41	2.43	1.45	3.47	1.26	2.86	2.71	2.40	0.94	1.38	2.01	0.96	1.87	2.79	3.15	.....	6.85	3.47	1.06	1.78
Both lugs off	7	8.04	6.12	.....	7.62	5.95	5 21	9.49	8.52	7.40	5.02	5.88	4.62	5.53	4.63	5 88	3.02	2.91	7.82	19.81	13.60	8.77	12.68	6.60	3.70	13.16	21.33	6.16	4.68	15.96	7.49
Both lugs cracked	8	0.31	0.26	.....	0.27	0.52	1.04	.....	0.21	0.44	.....	.....	0.34	0.09	0.77	0.42	0.26	0.97	0.33	0.71	0.16	0.43	0.08	0.20	0.23	.....	.....	.....	0.79	.....	0.40
Both lugs chipped	9	3.52	2.60	4.13	1.78	6.32	3.13	2.77	3.09	8.72	1.83	4 41	4.45	1.45	2.70	1.26	5.41	6.01	4.26	2.12	1.90	2.37	2.79	4.24	6.04	5.26	2.67	10 96	5.17	3.19	2.32
Upper lug off, lower cracked	10	0.95	0.39	1.65	0.86	0.73	.....	0.76	0.74	0.95	0.23	.....	0.58	0.63	0.59	1.26	0.52	0 39	0.91	1.18	2.13	1.10	1.00	0 69	0.15	.....	1.38	0 69	0.06	3.19	0.80
Lower lug off, upper cracked	11	0.32	0.26	.....	0.35	0.31	1.04	0 5	0.21	0.51	.....	.....	0.41	0.18	.....	.....	0.39	0.19	0.12	0.47	0.23	0 24	0.54	0.29	0.45	.....	1.33	0.69	0.12	1 06	0.53
Upper lug off, lower chipped	12	2.19	2.08	.....	1.83	1.83	1.04	2.60	2.56	3.15	1.14	.....	2.12	1.54	1.16	1.68	1.77	0.97	3.10	0.94	2.15	2.01	3.99	2.36	2.04	1.32	2.67	0.69	1.52	3.19	2.36
Lower lug off, upper chipped	13	2.31	1.43	0.83	2.26	2.92	2.08	3.95	4 26	5.86	2.28	4.41	1.99	1.27	2.32	2.10	3.25	2.32	1.99	4.01	0 97	1.44	2.70	2.46	2.87	1.32	5.33	2.05	2.13	2.13	2.59
Tail off	14	0.77	0.39	1.65	0.70	0.52	1.04	0.59	2.87	1.32	0.46	2.94	0.79	0 36	0.39	.....	0.43	0.19	1.08	1.18	0 70	0.65	0.5	0.89	1.81	1.32	.....	.....	0.24	5.32	0.76
Worn out		3.80	0.39	14.88	28.01	0.89	1.04	0.17	.....	1 10	25.80	1.47	0.96	0.72	0.77	.....	1.58	2.52	1.12	.....	1.10	1.17	1.10	1.58	2.04	.....	.....	0.69	1.09	.....	0.49
No defects observed		0.57	2.08	.....	0.38	0.16	.....	0 08	0.11	0.37	0.68	.....	0 96	.....	0.39	0.84	0.49	1.16	0 58	.....	1.20	0.34	0 1	0.30	0.30	.....	1.38	.....	0.37	.....	0.85
Miscellaneous		0.37	.....	.....	0.32	0.16	.....	0.08	.....	0.07	5.48	.....	0.24	0.09	.....	0.42	0.23	0.39	0.16	0.47	0.62	0.31	0.46	0.39	0.68	1.32	1.32	.....	0.12	.....	0.36
		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

N. B.—Three roads in the above table (viz., Balt. & Ohio, Ch'go, Burl. & Q., and Ches. & Ohio) had an unknown and indeterminable, but considerable, percentage of wrought iron PASSENGER knuckles mixed in with the freight knuckles. As passenger knuckles wear out by abrasion on the inner face many times faster than freight knuckles, as an effect of the buffer spring pressure, and rarely break from any cause, this admixture produces a very great difference in the "Worn Out" percentage of these roads. Though several other roads in the table are using Janney passenger couplers none others but these three use wrought iron knuckles for passenger service.

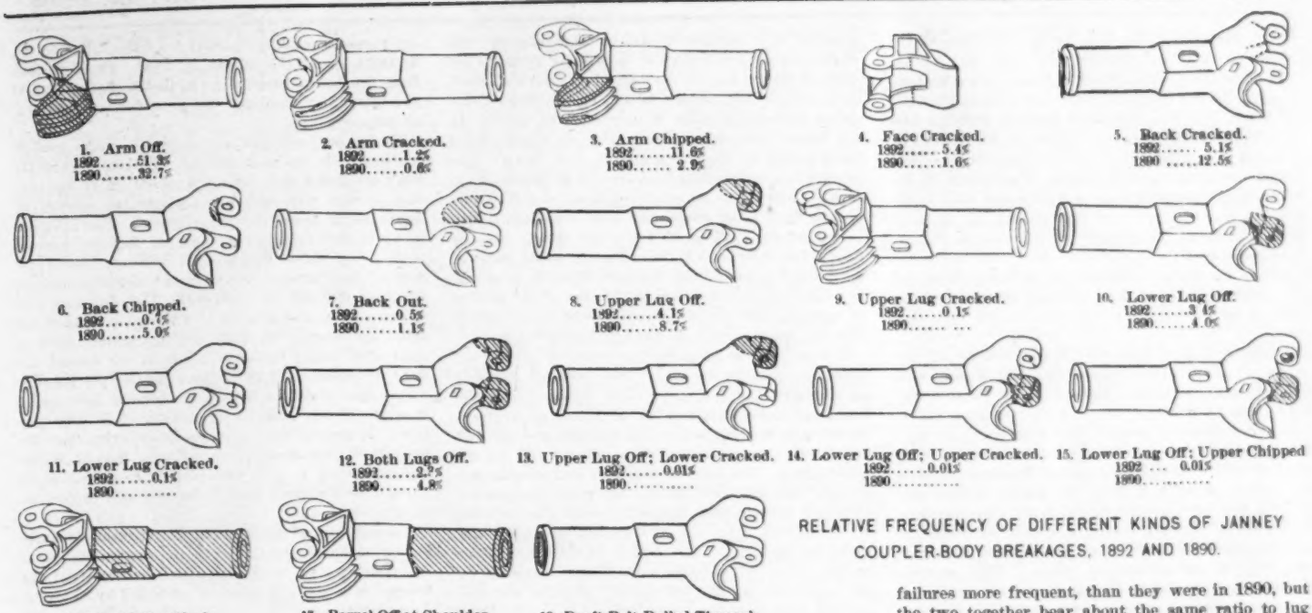
RELATIVE FREQUENCY OF BREAKAGES IN DIFFERENT PARTS OF JANNEY FREIGHT COUPLER BODIES.

As Determined by Percentage Computations from the Total Number of Breakages Reported by Each Railway from Jan. 1, 1886, to March 31, 1892.

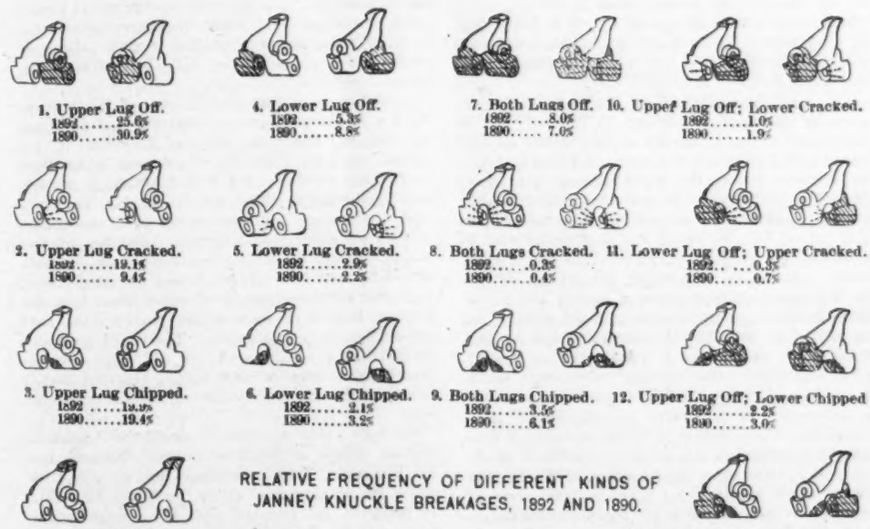
	Fig. No.	Gen'l Average.	Ally. Vall'y	Balto. & Ohio.	Ch'go Burl. & Q.	C., C. & St. L.	C'nda Cattle Car Co.	Ch'go Milw. & St. P.	Ch'go & N. W.	Ch'go, R. I. & Pac.	Ches. & Ohio.	Grand Rap. & Ind.	Lake Shore & M. S.	Le'igh Val'y.	No'thern Cent.	N. Y. C. & H. R.	N. Y., Ch'go & St. L.	N. Y., L. E. & W.	No'thern Pa'fic.	Penn. R. R.	Pa. Co. N. W.	Pa. Co. S. W.	Phil., Wilm. & Balto.	Rich. & Dan.	R'me, Wat. & Ogd.	Union Pac.	West Shore.	West. N. Y. & Penn.	Wis. Cent.	Misc.
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Arm off	1	51.28	23.45	44.01	39.40	50.69	42.43	61.42	56.89	40.56	52.00	42.86	43.29	43.94	69.01	28.94	16 67	25.76	67.41	63.82	60.54	51.10	68.12	33.80	.....	.....	51.02	17 17	18.65	47.06	40.89
Arm cracked	2	1.23	1.23	1.33	1.03	1.60	21.21	0.51	0.89	1.76	1.60	.....	3.00	4.04	0.94	3.37	4.55	0.76	0.37	0.47	1.70	0.31	.....	0.70	.....	.....	.....	4.04	4.15	3.92	2.08
Arm chipped	3	11.57	43.21	30.67	6.61	16.22	18.18	21.13	9.33	18.34	16.00	7.14	24.17	19.19	9.39	22.31	27.27	7.32	12.22	6.07	10.21	8.95	1.51	10 09	.....	.....	.....	15.15	32.64	5.88	12.24
Face cracked	4	5.44	7.41	.....	3.20	8.20	.....	5.03	4.22	4.23	7.20	14.29	10.90	11.11	2.82	9.79	13.64	4.98	0.74	2.57	9 89	6.92	1.81	8.69	.....	.....	.....	11.11	9.84	3.92	9.12
Back cracked	5	5.13	4 94	4.00	1.86	3.92	3.03	1.26	0.22	1.06	2.40	.....	3.60	7.07	1.41	7.07	15.91	21.13	1 48	3.11	2.84	3.46	..	3.29	.....	4.08	22.23	8.29	.....	.....	3.65
Back chipped	6	0.72	.....	4.00	0.21	1.42	3.03	0.18	.....	0.53	1.60	.....	0.79	0.51	0.47	3.26	6.06	0.88	0.37	0.23	0.32	0.63	0.36	1.17	.....	.....	4.04	2.59	.....	.....	0.26
Back out	7	0.51	.....	.....	0.52	0.36	.....	0.18	.....	0.35	.....	.....	0 16	1.01	.....	0.87	.....	1.11	.....	0.43	0.24	1.10	1.81	0.91	.....	.....	.....	.....	.....	.....	0.52
Upper lug off	8	4.09	2.47	4.00	4.13	2.32	3.03	1.17	3.78	2.12	5.60	21.43	1.89	2.02	4.22	1.42	2.27	3.69	3.71	5.00	6.24	5.82	6.89	4.46	.....	4.08	1.01	0.52	7.85	8.86
Upper lug cracked	9	0.15	.....	.....	.....	.....	.....	.....	.....	.....	0.80	.....	.....	0.51	.....	0.11	0.76	0.17	.....	0.10	0.65	0.16	.....	.....	.....	.....	.....	1.04	.....	.....	0.26
Lower lug off	10	3.39	4.94	4.00	3 72	3.03	3.03	2 34	3.78	4.06	1.60	.....	2.37	1.01	0.94	6.53	1.51	7 55	3.34	2.30	1.05	3.93	2.54	2.23	.....	8.17	5.05	2 59	.....	.....	5.99
Lower lug cracked	11	0.06	.....	.....	0.21	0.26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.12	.....	0.02	.....	.....	.....	.....	0.47	.....	.....	1.0'	.....	.....	.....	.....
Both lugs off	12	2.33	.....	1.33	2.58	2.32	.....	0.90	1.78	2.47	2.40	.....	1.42	2.52	1.88	1.96	1.51	4.45	2 96	2.36	0.89	3.14	3.62	3.52	.....	.....	1 01	1.01	1.96	2.08
Upper lug off, lower cracked	13	0.01	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.06	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lower lug off, upper cracked	14	0.01	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.06	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lower lug off, upper chipped	15	0.01	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.06	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Head off at neck	16	2.57	2.47	1.33	3.61	1.96	.....	1.35	12.45	1.76	2.40	.....	0.79	1.01	1.41	1.09	0.76	2.69	2 96	3.02	0.89	2.99	1.81	1.88	.....	.....	8.17	2.02	1.75	5.88	2.08
Barrel off at shoulder	17	6.25	7.41	2.67	10.85	6.24	6.06	3 60	4 60	10.76	2.40	7.14	4.74	3.03	3.75	8.27	3.03	4.51	2.96	6.31	2.03	5.98	4.71	19.25	.....	.....	20.40	9.09	8.81	13.72	7.03
Draft bolt pulled through	18	3.08	.....	1.33	0.62	1.07	.....	0.27	0.22	2.00	1.60	7.14	0.95	0.51	2.35	2 29	2.27	13.06	.....	1.73	0.65	4.40	6.16	2.11	.....	.....	2.04	5.05	4.68	1.96	2.60
Burnt		0.05	.....	.....	.....	.....	.....	.....	.....	.....	0.71	.....	.....	.....	.....	.....	.....	.....	.....	0.08	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Worn out		0.07	.....	.....	0.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.12	0.08	0.16	.....	.....	.....	.....	.....	.....	.....	.....	.....
No defects observed		0.58	.....	.....	0.21	.....	.....	.....	.....	1.23	.....	.....	0.16	.....	.....	.....	.....	0.41	.....	1 03	0.16	0.31	.....	5.40	.....	.....	.....	.....	.....	.....	.....
Miscellaneous		1.47	2.47	1.33	0.83	0.89	.....	0.63	2.44	1.06	2.40	.....	2 37	2 52	1.41	2.72	3.79	1.23	1.48	1.23	1.62	0.94	0.36	1.88	.....	.....	2.04	2 02	3 63	7.85	2.34
		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100 00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100 00	.....	100.00	100.00	100.00	100.00	100.00	100.00

SUMMARY OF THE ABOVE BY MAIN CLASSES OF FRACTURES.

Total arm fractures	64.08	67.89	76.01	67.04	67 91	81.82	83.09	67.11	60.06	69.60	50 00	70.46	67 17	79.34	54.62	48.49	33.84	80.00	70.36	72.45	60.06	69.93	44.59	.....	51.02	36.26	55.44	56.86	55.21
Total face and back fractures	11.80	12.35	8.00	5.79	13.90	6.06	6.65	4.44	6.17	11.20	14.29	14.85	19.70	4.70	20.99	35.61	28 10	2.89	6.34	13.29	12.11	3.98	14.09	.....	4.08	37.38	20.72	3.92	13.55
Total lug fractures	10.05	7.41	9.33	10.64	8.03	6.06	4 41	9.34	8.65	10.40	21.43	5.68	6.06	7.04	10.02	6.05	16.16	10.01	9.78	8.83	13.05	13.05	10.80	.....	12.25	8.08	5.19	9.81	17.19
Total barrel fractures	11.90	9.88	5.33	15.08	9.27	6.06	5.22	16.67	21.52	6.40	14.28	6.48	4.55	7.51	11.65	6.06	20.26	5.92	11.06	3.57	13.37	12.68	23.24	.....	30.61	16.16	15.02	21.56	11.71
Miscellaneous	2.17	2.47	1.33	1.45	0.89	.....	0.63	2.44	3.00	2.40	.....	2.53	2.52	1.41	2.72	3.79	1.64	1.48	2.46	1.86	1.41	0.36	7.28	.....	2.04	2.02	3.63	7.85	2.34
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	.....	100.00	100.00	100.00	100.00	100.00


1. Arm Off. 1892.....51.3% 1890.....32.7%
2. Arm Cracked. 1892.....1.2% 1890.....0.6%
3. Arm Chipped. 1892.....11.6% 1890..... 2.9%
4. Face Cracked. 1892.....5.4% 1890.....1.6%
5. Back Cracked. 1892..... 5.1% 1890 .....12.5%
6. Back Chipped. 1892.....0.1% 1890.....5.0%
7. Back Out. 1892.....0 5% 1890.....1.1%
8. Upper Lug Off. 1892.....4.1% 1890.....8.7%
9. Upper Lug Cracked. 1892.....0.1% 1890..... ...
10. Lower Lug Off. 1892.....3 1% 1890.....4.0%
11. Lower Lug Cracked. 1892.....0.1% 1890.....
12. Both Lugs Off. 1892.....2.7% 1890.....4.8%
13. Upper Lug Off; Lower Cracked. 1892.....0.01% 1890.....
14. Lower Lug Off; Uoper Cracked. 1892.....0.01% 1890.....
15. Lower Lug Off; Upper Chipped 1892 ... 0.01% 1890.....
16. Head Off at Neck. 1892.....2.6% 1890.....6.1%
17. Barrel Off at Shoulder. 1892..... 6.2% 1890.....12.2%
18. Draft Bolt Pulled Through. 1892.....3 1% 1890..... 2.0%

RELATIVE FREQUENCY OF DIFFERENT KINDS OF JANNEY COUPLER-BODY BREAKAGES, 1892 AND 1890.


1. Upper Lug Off. 1892.....25.6% 1890.....30.9%
4. Lower Lug Off. 1892.....5.3% 1890.....8.8%
7. Both Lugs Off. 1892.. ...8.0% 1890..... 7.0%
10. Upper Lug Off; Lower Cracked. 1892.....1.0% 1890.....1.9%
2. Upper Lug Cracked. 1892.....19.1% 1890..... 9.4%
5. Lower Lug Cracked. 1892.....2.9% 1890.....2.2%
8. Both Lugs Cracked. 1892.....0.3% 1890.....0.4%
11. Lower Lug Off; Upper Cracked. 1892.. ...0.3% 1890.....0.7%
3. Upper Lug Chipped. 1892 .....12.1% 1890.....19.4%
6. Lower Lug Chipped. 1892.....2.1% 1890.....3.2%
9. Both Lugs Chipped. 1892.....3.5% 1890.....6.1%
12. Upper Lug Off; Lower Chipped 1892.....2.2% 1890.....3.0%
14 Tail Off. 1892.....0. 3 1890..... 3.3%
13. Lower Lug Off; Upper Chipped 1892..... 2.3% 1890.....3.0%

RELATIVE FREQUENCY OF DIFFERENT KINDS OF JANNEY KNUCKLE BREAKAGES, 1892 AND 1890.

COUPLER BREAKAGES.

In our issue of Feb. 15, 1890, we gave the first detailed and complete records which up to that time had ever been published of the actual results of experience with 45,617 Janney freight couplers, the total number then in service from which returns had been received or were procurable. The average term of service for all these couplers was somewhat less than a year. Since that time a variety of partial records have appeared of the Janney and other freight couplers, but none covering such a great number of couplers in service as to make them very trustworthy guides as to prevailing tendencies.

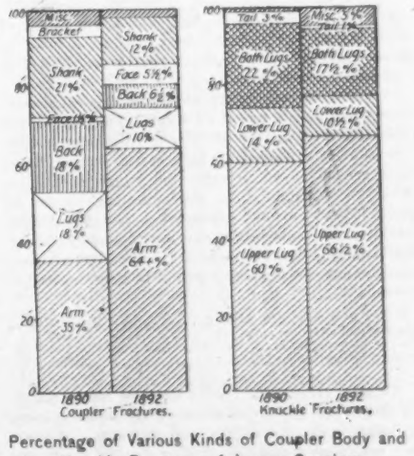
By the kindness of the McConway & Torley Co. we are now able to present in the accompanying tables the service record of 237,434 couplers and coupler knuckles, whose average term of service is nearly two years. The tables show the actual percentage of the various kinds of fractures subdivided under some 20 or more heads, for both coupler-bodies and knuckles, and for each road separately which has Janney couplers in use and has reported. We need hardly say that, as the manufacturers renew broken parts at very favorable rates, it is for the interest of all railway companies to promptly send in all broken parts for exchange, and that most of them do so. Of course there is some irregularity about it, and some broken parts will be covered up under piles of scrap and so not reach the manufacturers for a long time, if at all; but there is hardly enough of this, we should judge, to considerably affect these percentages, or even the total number of fractures reported.

To make the comparative indications of these returns for 1890 and 1892 more readily comprehensible, we have constructed the diagrams shown in the accompanying engraving. The most significant change in the coupler fractures (and a highly significant one) is the enormous increase in the proportion of arm fractures to 64 per cent. of all which occur (or practically two-thirds), instead of 35 per cent., or but little over one-third. We may be mistaken, but we are disposed to think that the cause of this tendency to arm fracture is not sufficiently covered by the prevalent explanations, sliding past each other of closed couplers, blows and strains on curves, etc. We suspect that there is another and more important cause which has not had due consideration. We will not attempt to give this now, but will do so later.

The relative frequency of lug to shank failures remains almost exactly as it was two years ago. The nearly proportional apparent decrease in their percentage is merely apparent, and due only to the great increase in the percentage of arm failures. Back failures are much less frequent, and face failures more frequent, than they were in 1890, but the two together bear about the same ratio to lug and shank failures that they did two years ago. The only great change which has occurred is the increase in arm failures.

In knuckle breakages the only change is a still greater tendency to preponderance of upper lug fractures and a decided tendency to decrease in tail fractures. The excess of upper lug failures is due to the drooping of the outer ends of the couplers, and is in spite of much extra strength. The apparent increase in number of "miscellaneous" fractures is due only to the inclusion of a certain proportion of passenger knuckles, which fail chiefly by wearing out, the buffer springs causing much more rapid abrasion than occurs in freight service, where the direct wear is very slow.

In order that the significance of the several percentages of coupler fractures may be more readily grasped, we add below the main table a summary giving sub-totals for the various main classes of fractures. It is proper also to call attention to the large proportion of mere chips or cracks, as indicating the toughness of the material.



Percentage of Various Kinds of Coupler Body and Knuckle Fractures of Janney Couplers.

The accompanying small engravings show the exact nature of each class of fracture (it being always remembered that the line of fracture varies more or less with every case, and the engraving shows merely the prevailing tendency); and beneath each engraving we have added the percentage of fracture for 1892, as given in the accompanying table, and also the corresponding percentage by our records of 1890. These records are well deserving of careful study. Some features of them, besides those which we have noted, we shall have occasion to return to in a later issue.

THE SEWERAGE OF THE DISTRICT OF COLUMBIA.

In accordance with an act of Congress making appropriations for the fiscal year ending June 30, 1890, President Harrison appointed Messrs. Rudolph Hering, Samuel M. Gray and Frederic P. Stearns as a board of sanitary engineers to examine into and report upon the existing system of sewerage in the District of Columbia, and to recommend such modification and extension of the system as to them seemed proper. The report of this board is now published, and as it embodies the very latest experience on sewage disposal, as deduced from the practice and study of three sanitary engineers of the highest authority, we make from it the following abstract:

These engineers first sketch the history of the sewerage of the District and the surrounding and controlling conditions. Before 1860 Washington was virtually a large village, with few large buildings, no well-paved streets, and practically no system of drainage other than a few roughly built brick sewers with flat bottoms and inadequate gradients. But in 1871 a board of public works was created and extensive municipal improvements were inaugurated. Among others, a system of sewerage was begun, dividing the city into drainage districts, but without comprehensive plan. The sewers planned discharged into the canal at such elevations as to preclude subsequent carriage to the river by sewers having a free discharge at high tide. This canal was subsequently filled up and two large sewers with flat bottoms were substituted; but the flow of sewage was retarded by the tide, and the nuisance of foul deposits was simply transferred to a somewhat more remote point. The sewers built at this time were insufficient in size for storm water removal and were badly ventilated.

In 1874, after 80 miles of sewers, mostly pipes, had been constructed, the board of public works was abolished and the government of the District placed under three commissioners; and in 1878 it was ordered that one of these commissioners should be appointed from the Corps of Engineers, U. S. Army, and the engineering work should be placed in his charge. A better system was inaugurated and a number of evils in the old system were corrected. In 1885 the growing necessity for a better disposal of the sewage brought out various plans to this end, but no definite steps were taken to carry out any of these plans until 1888, when an intercepting sewer was ordered to be built down the valley of Rock Creek, to eventually free this creek from its present offensive pollution. A part of this sewer is now under construction.

The last annual report of the engineer commissioner contains a report of Capt. Symonds on the reclamation of the low district of Washington city, now generally flooded at high stages of the river. It is recommended to raise the whole area to a minimum height of 1 ft. above the high water of June, 1889, at a total estimated cost of $2,020,694, including the replacing of pavements and other incidental work. The last annual District report shows that the present sewerage system is made up as follows:

Circular and concrete sewers	219,507 l. ft.
Egg-shaped sewers	73,138 "
Pipe sewers	1,016,103 "
Sewers laid prior to 1871	22,845 "
Total	252.2 miles, or 1,331,593 l. ft.

The present system of sewers is pronounced good in design and construction, and the board of sanitary engineers practically confine themselves to the study of a comprehensive system of sewerage and its disposal in an unobjectionable manner.

The question of sewage purification is first dealt with, with the following results: Subsidence would involve the construction of tanks of enormous area and cost, and a large annual cost for the removal of deposits. Straining through coarse filters will remove some of the solid matter, and is often advisable in land disposal to relieve the surface of the soil from bulky matter and reduce the amount of deposit when final disposal is in a water course. Chemical precipitation, by lime, salts of alumina and salts of iron, does not alone produce a complete purification of the sewage, though it is of great advantage as a preliminary to filtration through soil, in requiring a smaller area of land, and permitting disposal in a smaller stream without offense. The sludge, or deposited matter, containing about 90 per cent. of water, may be discharged on land and dried, or plowed under, carried to sea, or compressed into cakes containing about 50 per cent. of water. In the latter form it has some value as manure, and its removal to distant points is less costly. The process is an expensive one, costing in England annually from 20 to 40 cents per head of population, and in the United States the cost is variously estimated at from 37 to 75 cents per head. As the works for treatment in Washington would have to be located south of the Eastern Branch, it would not result in any reduction in the cost of the system of sewers, and the treatment would be so costly that the board gave it no further consideration.

Sewage can be completely purified by proper application upon porous land. The operation is about as follows: The sewage is first strained and the larger particles retained at or near the surface, where they are exposed to the sunlight and air and are largely broken up by these effects and do not accumulate. The minute particles and soluble impurities descend, and, unless too great a quantity of water is used, they dampen or coat the particles of earth and sand. In the second operation the sufficient exposure of the sewage in these thin films to the action of microbes and oxygen contained in the interstices of the soil rapidly changes the impurities into harmless compounds. A warm temperature is more favorable to bacterial action than a cold one, and more favorable to the purification of the sewage. As sewage, even in winter, rarely drops below a temperature of 42°, it is found that in much colder places than Washington neither the filtration through land nor the purification of the sewage is seriously interfered with.

The practical conditions for land purification are given by the board as follows: (1) The soil must be sufficiently porous to allow a given quantity of sewage to percolate slowly to a depth of 4 to 6 ft. below the surface, and at this point natural or artificial drainage should freely remove the purified water. (2) The application of sewage must be uniform, so that the soil becomes evenly and moderately wet. It must also be intermittent, so that the soil is alternately exposed to a thorough penetration of air. (3) The purification requires a certain amount of time, depending on the character of the sewage, the porosity of the soil, the air temperature and the condition of the soil in regard to the existence of nitrifying organisms. The quantity of sewage which can be disposed of on an acre of land can thus only be determined by a careful investigation of local conditions. From 10,000 to 30,000 gallons per acre have been purified in this manner in different localities, and at these rates the filtrating of Washington sewage would require from 1,200 to 3,600 acres of land. (4) Where the soil is not porous, broad irrigation will allow sewage to be purified, at least in warm climates. In this process a thin sheet of sewage is allowed to flow uniformly over a large surface of gently sloping grass land. The suspended matter is retained on the surface, and the dissolved matter is oxidized by a thorough exposure to sun and air. A regular and level territory and a much larger area than for intermittent filtration is required, and under the prevailing conditions at Washington a sewage farm would be financially unsuccessful, says the board.

In examining the ground south of the Eastern Branch, with filtration in view, the board found that the soil was in some places fairly porous, but in others it was clayey and impervious. Assuming that as much as 20,000 gallons of sewage per acre per day could be used, it would require for a population of 500,000 nearly six square miles. This amount of flat land is not available at this point, and the scheme is not recommended.

The board then devoted itself to the consideration of sewage discharge into the Potomac River. They find that at a point just below the Eastern Branch the Potomac has a drainage area of 12,555 square miles, with an annual rainfall of 41 ins. on this watershed. If 55 per cent. of this rainfall finds its way into the streams—a fairly assumed proportion under the existing conditions—the average discharge of the Potomac at Washington would be at the rate of 20,600 cu. ft. per second. Records of low water discharge at this point are few, but 1,063 cu. ft. per second is reported for 1855; 1,904 cu. ft. in 1839, and 2,183 cu. ft. in 1863. From various data the board assumes a minimum flow of 1,100 cu. ft., and an ordinary dry year flow of 2,300 cu. ft. per second.

The amount of dilution required to make sewage inoffensive is not well defined. Various authorities have concluded that from 1.5 to 3.3 cu. ft. per second of flow will sufficiently dilute the sewage of 1,000 people to prevent offensiveness. This is equivalent to 969 to 2,133 gallons per day per person. And using these figures, the ordinary low-water flow of the Potomac would provide for a population of from 690,000 to 1,567,000. The drainage and water supply commission of Chicago recommended that the sewage of that city be diluted with a volume of water equal to 4 cu. ft. per second per 1,000 inhabitants (2,585 gallons per day per person). Upon this basis the Potomac ordinary low water flow would take care of the sewage of 575,000 persons. It should be remembered, however, that the sewage of Chicago is more foul than that of Washington, owing to the foul matter from the stock yards and slaughter houses being added to the domestic sewage.

Another way of determining the effect of discharging sewage into streams is to determine the chemical character of the water which has received the sewage of a given population, as found by analysis. Among the many constituents of sewage free ammonia furnishes the best indication of the amount of decomposition that has taken place, though the ammonia contained in a gallon of sewage varies greatly with the amount of water used per capita. The ratio of ammonia to population is much more constant and is about 15 lbs. daily per 1,000 inhabitants.

Applying these figures to the case of Washington, with a future population of 500,000, and assuming an ordinary low water flow of 2,300 cu. ft. per second, we have 7,500 lbs. of ammonia added from the sewage per day. A flow of 2,300 cu. ft. per second equals 12,400 million pounds per day, and hence with the sewage uniformly mixed each one million pounds of water would contain 0.605 lbs. of ammonia. Water containing this amount of ammonia would be unfit to drink, but would not be offensive, and analysis of one sample of water taken from the Eastern Branch shows it to now contain 0.660 part per million of free ammonia. The board concludes finally that the Potomac River will dispose of the sewage of at least 800,000 people, provided that it is uniformly mixed with the whole volume of the river.

The board then considers in detail the location of various outlets or points of sewage discharge into the Potomac. They recommend first an outlet opposite the point of land above the Naval Magazine, as being so far removed that the sewage cannot return on the flood tide. An outlet into the main channel opposite Gravelly Point would probably not produce any objectionable effects for the next 15 or 20 years. The report then treats of the protection of the low portions of the city from river floods, and the collection and delivery of the sewage at the outfall and removal of storm water.

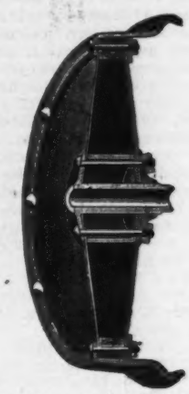
The conclusions of the board may be condensed as follows: The proposed plan includes deeply laid intercepting sewers to carry practically all the sewage to an outlet in deep water; storm-water sewers to drain the low district and to intercept water which would otherwise reach it from the higher districts; dikes to keep out river water during freshets; pumps to lift the sewage at all times and the storm water from the low district at unusually high river. The estimated cost of the work is $3,598,003, with $143,920 for annual interest and depreciation and $19,920 for annual cost of pumping, or $163,840 as a total annual cost.

THE KALAMAZOO STEEL HAND-CAR WHEEL.

We show herewith a section of the hand-car wheel which has been designed by the Kalamazoo Railroad Velocipede & Car Co., and adopted by it in place of the combination wood and paper wheel with steel tire which was formerly used. The tire of the new wheel is of pressed steel, 3-16-in. thick, and its flange and tread correspond to the M. C. B. standard. In this way the danger of climbing frogs and switch points which existed with the old style hand

car wheel, with its thin flange and narrow tread, is obviated.

The web of the wheel consists of two disks of sheet steel, No. 16 gage, separated at the rim by a wooden felloe and joined to a malleable iron hub. Four through bolts at the hub and eight at the felloe hold the parts of the wheel together. These bolts are of ½-in. steel, and after screwing up the nuts the ends are riveted over. The disks are given their dished form under a drop press. The manu-



Section of Kalamazoo Steel Hand Car Wheel.

facturers claim that the pressed steel tire is more truly cylindrical than a tire made by rolling. They state that the strength of the wheel has been tested by putting a shaft through the hub, each end having a bearing outside the hub, and applying 21 tons pressure on the outside of the wheel. Under this excessive load the plates did not buckle.

The wheel has an evident advantage over the wheels constructed partly of wood or paper in that it cannot shrink or warp when subjected to heat or exposed to rain, and it has a great excess of strength.

It might be thought that the metal plates of the wheel would cause it to be noisy in running; but we understand the wooden felloe is to be put in to check vibration and make the wheel run quietly.

The highway bridge from Galveston Island to the mainland will be about 10,000 ft. long and will cost $200,000. The trusses will be of the arched lattice girder type, and will be built of mild steel. There will be about 120 concrete piers. The foundations will be in from 6 ft. to 9 ft. of water, with hard sand, shell and clay bottom. The Missouri Valley Bridge & Iron Works, of Leavenworth, Kan., has the contract, the work to be completed in July, 1893.

PERSONALS.

Mr. G. F. Wightman has been appointed City Engineer of Peoria, Ill.

Mr. H. C. Green has been appointed City Engineer of Mitchell, S. Dak.

Mr. James T. Douglas has been appointed City Engineer of Chester, Ill.

Mr. W. W. Legrande, civil engineer and electrician, died at Louisville, Ky., May 4.

Mr. J. J. O'Neill has been reappointed Township Engineer of East Orange, N. J.

Mr. John E. Bailey has been elected Sewer Commissioner of Newburyport, Mass.

Mr. S. H. H. Clark has been made President of the Union Pacific R. R. Co., and will have his headquarters at Omaha, Neb.

Mr C. A. Alderman has been reappointed City Engineer of Eau Claire, Wis., He has held the position for three years.

Mr. O. F. Nichols, Chief Engineer of the Brooklyn Elevated R. R., has been appointed General Manager, vice Col. Martin, resigned.

Mr. W. G. Raymond, of the firm of Raymond & Bay, civil engineers, San Francisco, has been appointed City Engineer of Berkeley, Cal.

Mr. F. Atkins, an engineer engaged on the construction of the Astoria & Portland R. R., was drowned in Young's River, Oregon, April 29.

Mr. J. S. Keerl has been appointed City Engineer of Helena, Mont. He was for nearly five years the Secretary of the Montana Society of Civil Engineers.

Mr. Charles Elliott, Superintendent and Engineer of the Spring Valley Water-Works, died in San Francisco, Cal., April 27. He was formerly Engineer of the old San Francisco Water Co.

Mr. Lester L. Robinson, railway contractor, died in California, May 6. He built the Atlanta & St. Lawrence R. R., from Portland, Me., to Montreal, Que. (now owned by the Grand Trunk Ry.), in 1844.

Mr. William P. Shinn, ex-President of the American Society of Civil Engineers, and of the American Institute of Mining Engineers, and a prominent engineer and railway man for nearly half a century, died at his home in Homewood, Pa., May 5, lacking only nine days of being 58 years of age. We published a biography and portrait of Mr. Shinn in our issue of Dec. 20, 1890, giving a record of his professional career. Since that time Mr. Shinn has been at work on a large concentrating plant at the Croton Falls, N. Y., iron mines, and was busy on this work at the time of his recent fatal illness.

Professor Mansfield Merriman, of Lehigh University, writes us: "In the Philadelphia Press of May 3 appeared the statement that I had been offered a professorship in Chicago University. As this is not true, please do not allow the item to get into Engineering News."

The item did appear in our last issue, however, the above note having been received too late to prevent it. We will only add that the Chicago University might go farther and fare a good deal worse.

Sir James Allport, a director of the Midland Railway Co., of England, and one of the leading railway men in England, died in London, April 25, at the age of 81. He was born in Birmingham in 1811, entered the service of the Birmingham & Derby Ry. in 1839, and in 1843 became Manager of that road, which was the beginning of the present Midland Railway system. In 1850 he went to the Manchester, Sheffield & Lincolnshire Ry., and in 1853 was appointed General Manager of the Midland Railway, which position he held for 27 years, or until 1880, when he resigned and was elected a Director of the company. He was knighted in 1884. He was an Associate Member of the Institution of Civil Engineers, and a Director of the General Hydraulic Power Co., Samuel Fox & Co., the United Asbestos Co. and other firms. His great work was the development of the Midland Railway, and the introduction of many novel ideas which made that one of the leading and most progressive of English railways. He induced the company in 1872 to put third-class cars on all trains, and in 1875 to abandon the second class. This latter example has since been followed by three or four other companies. He also first introduced Pullman cars in England. In 1883 he came to the United States with Mr. Swarbrick, late General Manager of the Great Eastern Ry., to report on the condition of the New York, Pennsylvania & Ohio R. R., on behalf of some of the bondholders, and in 1886 he was appointed to preside over the Royal Commission which inquired into the railways of Ireland, and the means of providing better railway and harbor facilities, and of improving the drainage of that country.

NEW PUBLICATIONS.

A TEXT-BOOK ON RETAINING WALLS AND MASONRY DAMS. By Mansfield Merriman, Prof. C. E., Lehigh Univ. New York: John Wiley & Sons; 8vo., pp. 122; 31 cuts; $2.

About 93 pages of this work are devoted to retaining walls, and the remaining 30 pages to dams, the latter being studied only in regard to their cross section. The book is chiefly devoted to the theory of its subject, giving but little space to practical questions of construction, or to comparisons of the dimensions given by the formulas with those which have been successfully used in practice, or to recording such much used rules of thumb as that the base thickness of retaining walls at every point shall be 0.4 × height at least above that point.

This we consider unfortunate for the reader and the author. It is a very easy thing for anyone to compile from technical literature a long table of the proportions of actual retaining walls, and of actual dams, which have or have not failed. An author who gets out a book, especially devoted to these two subjects only (and a very thin one in proportion to its price, we may add), owes it to himself and to his public, it seems to us, to fortify his theory by direct comparison with the results of experience, even if his intended public be chiefly college students. Had this been done, the work would have been a greatly more valuable one for the library of the practicing engineer, as well as the student. Without it, it is still a valuable work, but it is not in itself a trustworthy guide either to the one or the other.

We observe with pleasure, however, that the theory of retaining walls has been radically revised since the present writer was a student; it has been made to jibe pretty well with practice. Formerly it was frightfully at odds with it, giving walls much thinner, as a rule, than any engineer who was posted ever dreamt of trusting to in practice. So far as we can determine without too much labor, the formulas in this book are not open to this objection. Just how the change has been effected we do not know, but it has been done very effectually, at least within the range of the examples given in the book (two or three excepted) and of the following computations, which we have taken the trouble to make for ourselves, and we trust correctly.

The bottom thickness in feet required by Eq. (61) for a wall 18 ft. high, 2 ft. thick on top, and built of ashlar masonry, weighing 165 lbs. per cu. ft., is under various conditions as follows:

	Earth surface level.	Earth surcharged 1½ to 1.	Sustaining water.
Back sloping 10° backward	5.96	9.56	10.40
" vertical	6.78	10.83	10.27
" sloping 10° forward	7.65	12.30	10.40

For the same wall, built of coarse brick masonry weighing 100 lbs. per cu. ft., instead of ashlar masonry, but otherwise the same, we have:

	Earth surface level.	Earth surcharged 1½ to 1.	Sustaining water.
Back sloping 10° backward	7.74	12.24	13.51
" vertical	8.83	13.91	13.40
" sloping 10° forward	9.99	16.00	13.51

The thumb rule of 0.4 × height would give 7.2 ft. for the base thickness in all of these cases.

We do not believe that any well posted engineer would make the difference which these tables indicate between surcharged and level earth, nor that he would ever dream of making a thicker wall to sustain a surcharged earth bank than to sustain water, nor that he would ever under any circumstances (though perhaps he ought to), with however well built masonry, trust a wall 5.96 ft. thick at bottom and 2 ft. thick on top to sustain a back of earth 18 ft. high, even if it did lean 10° backward. But on the whole, this little table agrees fairly well with what experience indicates; better than any other purely theoretical table we ever saw. Will the same be true if the formulas be tested within wider limits, to all extremes of practice? We do not know. Neither can any one else know unless he investigates for himself, and if he has paid $2 for a book on the single subject of retaining walls in the reasonable expectation of finding in it all that is generally known or can be easily ascertained on that subject, he will have a right to feel wronged and injured that he cannot satisfy himself on this point from the book alone.

This is especially so because, after all, the whole theory of retaining walls rests upon dubious premises, which are stated on the very first page of this treatise as follows:

The friction of earth upon earth will be taken to be governed by the same approximate laws as for other materials, viz.:

1. The force of friction between two surfaces is directly proportional to the normal pressure.
2. It varies with the nature of the material.
3. It is independent of the area of contact.

Now, these four clauses contain just four misstatements or imperfect statements: (1) "Other materials" are not governed by these same laws, even approximately, though mathematicians seem reluctant to admit that fact; (2-3) there is not the slightest experimental reason to believe that earth, of all substances, is governed by alleged laws 1 and 3, but there are very strong reasons to believe that it is not; (4) law 2 should be extended to read that the force of friction not only varies with the nature of the material, but varies with the condition of the same material from day to day and from hour to hour.

These facts knock the bottom completely out of all attempts to determine theoretically the actual pressure against the back of a retaining wall within 100 per cent. of accuracy, and hence to determine by computation what the actual proportions of a retaining wall should be. Every old engineer has had instances in his own practice where the pressure against the back of a new retaining wall has been zero, because the material stood vertical, but where it has later developed a capacity to expand almost to infinity, by walking off with the wall bodily, and perhaps carrying it a hundred yards or more.

But nevertheless, it still remains true that a study of the theory of retaining walls is a necessary preliminary to the intelligent designing of such walls, not because we can trust to the computations for exact proportions, but because it enables us intelligently to weigh the effect of varying conditions or proportions; and in respect to its discussion of the theory, which is all that the book attempts to cover, we must in justice speak highly of it, and we gladly do so. As a whole we like the work very much, regretting only its omissions. Otherwise we should not take the trouble to review it at such length. The language is clearness itself. The mathematical work is simple and easily followed, and directly to the point. Everything in the book has a direct practical bearing. There is an evident effort to keep it so, and to avoid hair splitting distinctions. There are some demonstrations which are new to us

at least and point out valuable truths. The values of the algebraic symbols are given as often as convenience requires, thus correcting a grave fault of some of Prof. Merriman's earlier books. Above all, there is the peculiarity already noted, that, however imperfect the actual basis of the formulas may be, the walls proportioned by them will rarely be lighter than experience warrants, though they may be heavier.

One chapter which we particularly like is the first one, on the stability of earthwork, and especially Art. 5 therein, on "Curved Slopes and Terraces." Prof. Merriman declares: "The preceding theory (that a high slope to be stable should be concave, and not flat) is not new, having long since been set forth in many French and German books, but the author is unaware to what extent it is practically used in those countries." There can be no doubt that it is practically used in this country very little, and yet there can be as little doubt that it exactly corresponds with the facts of experience. In a small cut it may not much matter, but in a 30-ft. cut or over the all but invariable result of cutting the slope flat instead of concave is that slipping and washing of material soon begins, and does not stop until the material has adjusted itself to a concave slope. If the same area of section were adjusted to concave instead of straight slopes, we have little doubt that a very material economy in subsequent maintenance expenses would result in many cases. But instead of doing this it is much more usual to let the contractor belly the slopes (which is difficult to detect by the eye unless excessive), and thus get paid for material which he does not take out, and which is almost sure to provoke a tendency to slide.

We trust Prof. Merriman, and all other professors, will drill this theory into his students until they have grasped it thoroughly. Another feature of the work which we observe with pleasure, and believe to be of real value, is the stress laid upon the advantageous effect of battering the back of a wall backward. Too little attention has been paid to the advantage which may thus be gained, in designing retaining walls. In certain circumstances, as in walls for sunken railway tracks in cities, space cannot be taken to batter back even the face of the walls, much less the back; but where the only controlling condition is to get the utmost possible stability out of a yard of masonry a large economy can be realized, or else a great increase in factor of safety, by making both faces of the wall slant against the backing. This is demonstrated very completely and clearly.

These two features alone make the work of real and end special value. We therefore feel safe in saying as much for it. Had it been elaborated on the practical side it would be greatly more valuable.

STATISTICAL ABSTRACT OF THE UNITED STATES, 1891. Fourteenth Number.—Finance, Coinage, Commerce, Immigration, Shipping, The Postal Service, Population, Railroads, Agriculture, Etc.; Pub. Doc., Bureau of Statistics; 8vo., pp. 344.

There are always certain interesting facts given in this annual publication to show which clearly requires that the figures should be abstracted for several years back. As we did this for the last issue, we cannot attempt to do it for this one, however, and content ourselves with taking off a few notes only. All the figures, unless otherwise stated, are for the fiscal year ending June 30, 1891.

The cash in the Treasury has now reached the enormous aggregate of $726,222,333 against only $280,000,000 in 1881. About two-thirds of this vast sum, we believe, is silver bullion. The total interest-bearing debt of the United States is now only $610,529,000, costing only $23,616,000 per year for interest, or 37 cts. per inhabitant, against 47 cts. in 1890, and $1.46 in 1881. The total debt, less cash in treasury, is only $852,000,000, or $13.32 per capita, to which is to be added $18.13 of state, county, city and other local indebtedness, against $22.40 of such indebtedness in 1880.

The commercial failures of last year were considerably more numerous (about as 12 to 11) than for the two years before. The average percentage of failures was 1.07, highest on the Pacific coast (2.21) and lowest in the West (0.77). Last year's percentage has only been exceeded twice in 13 years, and then but slightly. The total liabilities were exceeded only in 1884. Altogether, last year was rather a poor business year. The per capita circulation last year was $23.41, the largest since 1869 (when it was $17.60) and probably the largest on record.

In the last four years savings bank deposits have increased about 25 per cent., to the great sum of $1,632,000,000, the average deposit being $358, and the total number of depositors 4,533,217, representing fully one-third of the families in the United States. These deposits are in 34 states, but the deposits exceed those of Delaware (3.6 millions) in only 16 states. Massachusetts and New York alone have much more than half of the total. Considering how poorly provided the South and West is with savings banks, these figures certainly indicate that the people of the United States are pretty forehanded.

The bank clearings fell off about 6 per cent., to the trifling sum of $56,803,000,000, 60 per cent. of which was in New York city alone. Chicago had less than Boston, and only 7½ per cent. of the total. It has, therefore, still a chance to grow.

Gold production has stood about constant since 1880 at $33,000,000. Silver production has increased from $39,000,000 to $70,500,000 in the same time, coinage values. Coal production has just doubled in ten years. Petroleum production has about doubled in five years, but the quantity exported has increased only 20 per cent., and its value has slightly decreased.

The Americans are becoming yearly greater beer drinkers. Last year showed a large increase to 15.28 gallons per head, against 11.20 in 1886. Hard liquor consumption has also increased in the same time from 1.26 to 1.42 gallons. Wine consumption is undoubtedly increasing, but is only about half a gallon per head, and no accurate reports are available.

Our sea-going tonnage has reached the respectable aggregate of 4,685,000 tons, an increase of 580,000 tons since 1887, the steam tonnage only being 2,016,000 tons, an increase of about 25 per cent. in four years. The steam tonnage built last year (185,000 tons) was very much larger than ever before, and the sailing tonnage built has not been exceeded since 1875, and is about twice the average since that date. It looks as if our marine interests were taking an upward start again.

The number of patents issued was only 23,244, which is about the average since 1883, and 3,000 less than in 1890. The Patent Office has a chronic surplus of receipts of about $200,000 yearly. About 5,000 more applications yearly are rejected now than in 1883, being now nearly half of the whole.

Much more interesting information may be extracted from the tables of this volume, which is an interesting one to look over, but we must let this suffice.

NOTES AND EXAMPLES IN MECHANICS; with an Appendix on the Graphical Statics of Mechanism. By Irving P. Church, C. E., Associate Professor of Civil Engineering, Cornell University. New York: John Wiley & Sons, 8vo., pp. 118+28; 155 illustrations. $2.00.

This is a text book intended for a companion volume to the author's "Mechanics of Engineering," and, interpreted by a good teacher in the class room, may be a very useful book. The author has certainly hit on the right scheme for making mechanics of value to the student by showing how the knowledge he acquires is at every step directly applicable to the solution of practical problems. The average student is apt to emerge from the class room with an exaggerated idea of the real office of mathematics; and it takes him a long time to learn that aside from their value as an intellectual gymnastic, their chief usefulness consists in the fact that they are an aid to correct reasoning. The criticism to be made on this book, as on most text books, is that it contains too much algebra and too little explanation of the "Why." The youth attempting to study mechanics by himself would find much to stumble over in this book, as he would, it is fair to say, in most text books on this subject.

THE TECHNICAL INDEX.—Published monthly by the Engineering Magazine Co., New York city. 8vo., pp. 12; $2 per annum.

The first issue of this new periodical indexes some 500 articles in the principal American and English technical journals. The indexing consists in classifying the articles under different heads, such as Architecture, Civil Engineering, Electricity, Mechanical Engineering, Photography, etc., but otherwise no classification is attempted. The trouble with such an arrangement is that it is difficult to know always where to look for articles on a desired subject. For example, we find a discussion on tests of iron and steel under "Mining," while another article on "Elastic Tests of Iron and Steel" is put under "Miscellaneous." Again, an important article nowadays is generally published by several of the technical papers simultaneously. This index credits them to a single one only. What improvements the publishers will make remains to be seen; but in its present form the index impresses us as not nearly so convenient or valuable as the index which has for some years been published in connection with the "Journal of the Association of Engineering Societies."

REPORT OF THE SUPERINTENDENT OF THE U. S. COAST AND GEODETIC SURVEY.—Showing the Progress of the Work during the Year ending with June, 1890. T. C. Mendenhall, Supt. Pub. Doc., 4to., pp. 780; 71 folding plates.

Apart from the usual progress reports, the results of very elaborate scientific and historical research as to the Gulf Stream are beautifully given in this volume, and in a very interesting way. Some extensive magnetic observations are also given, and scientific notes relating to weights and measures. We hope to make an abstract of some of the facts determined in relation to the Gulf Stream at some later date.

CITY REPORTS.—The following city reports, mostly those of city engineers, have been received:

Nashua, N. H., H. B. Burley, City Engineer; Boston, Mass., H. H. Carter, Superintendent of Streets, H. B. Wood, Executive Engineer; Fitchburg, Mass., D. A. Hartwell, City Engineer; Lenox, Mass., G. W. Folsom, Superintendent of Streets; Medford, Mass., J. P. Prichard, Superintendent of Streets; Montclair, N. J., H. L. Yost, Township Clerk; Altoona, Pa., Harvey Linton, City Engineer; Rockford, Ill., D. C. Dunlap, City Engineer; Minneapolis, Minn., Andrew Rinker, City Engineer; Topeka, Kan., Lewis Kingman, City Engineer.

BLOWPIPE ANALYSIS, by J. Landauer, Member of the Imperial German Academy of Naturalists. Authorized English edition by Jas. Taylor, B. Sc., Wh. Sc.; A. R. L. M. Second edition, revised and enlarged. London and New York: Macmillan & Co., 12mo., pp. 173; 20 illustrations; $1.10.

Though blowpipe analysis is not the most useful, it is among the most interesting of the processes pursued in the chemical laboratory. The few and simple tools and reagents required make it often the most convenient process, especially for the use of the metallurgist or the mining engineer. This little hand-book seems to be admirably suited either for self-instruction or for a student's desk book in a college laboratory. The author explains not only the usual blowpipe work with the use of charcoal, or borax beads, but also the flame reactions produced with the Bunsen burner, according to the system first developed by Bunsen. The student is aided by convenient reference tables showing the reactions of different substances under various treatments. The book has the excellent typography which characterizes English technical books; but the publishers should not have issued the edition for the American trade with uncut tops. It tries the patience of reviewers, and will doubtless have the same effect on many a busy reader.

TRADE PUBLICATIONS.

FLUSH TANKS.—The Van Vranken Improved Automatic Flush Tank. B. Van Vranken, Schenectady, N. Y. 8vo., pp. 23.

This pamphlet contains a description, with illustrations and a price list, of the Van Vranken flush tank for sewers. There are a number of testimonials and some tables of useful information respecting velocity, discharge and quantity of water for flushing, quantities of material in sewers, etc., compiled by J. L. Fitzgerald, Sanitary Engineer, Schenectady.

ROLLS.—Niles Tool Works, Hamilton, O. 8vo., pp. 28.

This is an illustrated catalogue of bending and straightening rolls for iron and steel plates, including horizontal and vertical machines.

PUMPING ENGINES.—Henry R. Worthington, New York, 1892. 12mo., pp. 96.

This is an illustrated and descriptive general catalogue of the Worthington pumping engines, steam pumps, hydraulic machinery and water meters, giving dimensions, capacity and other particulars of pumps for various purposes. Other designs will be shown in special catalogues, now in preparation.

SOCIETY PROCEEDINGS.

NEW YORK RAILROAD CLUB.—The next meeting will be held 7:30 p. m., May 19, at the rooms of the American Society of Mechanical Engineers, 12 West 31st St. A paper will be presented by Mr. D. L. Barnes on "Draft Rigging for Freight Cars," and will be illustrated by the stereopticon.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.—At a meeting of the Department of Engineering on May 9, Mr. Robert L. Harris, M. Am. Soc. C. E., gave an interesting lecture on "Hydraulic Foundations," describing the methods invented by him for dealing with coarse and fine material in place. In coarse material, such as rip rap, a solid foundation, wall, etc., may be formed by successive injections of cement grouting which will form accretions on the stones and thus gradually close the interstices (Eng. News, March 14, 1891). In fine material, such as sand, quicksand, etc., a cementing material is forced in which will combine with the quicksand, etc., to form a solid mass or artificial rock. The latter method, and the process of working it, were described in Engineering News, April 28, 1892. The lecture was listened to with interest and was followed by some discussion. Samples of material were exhibited. A vote of thanks was tendered Mr. Harris.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The Raymond & Whitcomb excursion train, chartered to convey the San Francisco Convention party from New York to San Francisco and return, left New York May 4, at 9:30 a. m. Headquarters will be at the Palace Hotel, San Francisco, from May 16 to 20, and sessions will be held in the Academy of Science Building, San Francisco. The party consisted of about 76 people when it reached Chicago. It consisted of the following:

D. Ainsworth,* G. I. Alden, E. Andrews,* J. T. Boyd, T. J. Borden, A. Betts,* W. B. Cogswell,* W. G. Cotton, F. H. Daniels,* T. Hibbard, C. W. Hunt,* R. W. Hunt,* H. S. Haskins,* M. P. Higgins,* F. R. Hutton, Secy. V. G. Hazard,* Washington Jones, D. S. Jacobus, J. Knickerbacker, F. H. Laforge, W. Lewis, W. Monaghan, D. G. Moore,* F. J. Miller, F. Martens, F. M. Power, E. H. Parks,* F. E. Shepard, Joel Sharp,* Geo. H. Smith,* F. A. Scheffler, A. Sterns,* Gilbert S. Smith, H. G. Torrey,* C. N. Trump,* J. W. Tynam,* W. S. Wellman,

* The names starred are those of members with ladies accompanying them.

S. T. Wellman,* W. H. Wiley,* J. D. Williamson,* W. C. Williamson;* in all 43 members and 33 ladies.

The train was run through on the 24-hour system. Stops were made for members to join the party at Buffalo, Niagara Falls, Suspension Bridge, Chicago, Manitou Springs, Canyon City, Salida, Glenwood Springs, Salt Lake City, Sacramento, Monterey, thence to San Francisco. At Chicago, on May 5, the party was met by a local committee, in charge of Mr. H. F. J. Porter, Mechanical Engineer of the World's Columbian Exposition, who escorted them around the Fair grounds. In the absence of Mr. Burnham, addresses of welcome were made in the Women's Building by Mr. Porter and Mr. J. Allison.

The time at Chicago was spent chiefly about the World's Fair Grounds. A hand-book containing a map of the grounds and other data, enabled the visitors to form intelligible ideas of the real greatness of the forthcoming Exposition. From the Woman's Building the party boarded flat cars, arranged for the purpose, and were drawn around the entire grounds, stopping at and passing through the principal buildings. Carriages then conveyed the party to various parts of the city to view places of interest until 5 p. m., when they left via the Chicago, Rock Island & Pacific.

LIVERPOOL ENGINEERING SOCIETY.—At the meeting of this English society on April 20, a paper on "Refuse Destructors" was read by Mr. H. Percy Boulnois. After describing house refuse and the different methods of collection, he recapitulated the various methods at present adopted for disposal, and gave a description of the manner in which the greater portion of the refuse of Liverpool is barged away to sea and sunk in deep water. He then described in detail the various destructors which are now being erected in different parts of the country, including the twelve-cell destructor, on the "Fryer" principle, which he had recently erected for the corporation of Liverpool, and a new method of charging which has been adapted thereto. In conclusion he stated his opinion that the burning of town refuse was at present the best and most sanitary method known for dealing with such material, and although the cost may be slightly in excess of other methods of disposal, the safety of such an operation from a sanitary point of view more than counterbalances any small increase in the case for its disposal.

AMERICAN WATER-WORKS ASSOCIATION.—The annual meeting of the association will be held May 17 to 20, in this city, at the Metropolitan Hotel. The first session will open at 10 a. m., May 17, and will be devoted to business. At the afternoon session the following papers will be read: "The Brooklyn Water-Works," by Samuel McElroy; "Who Should Do the Plumbing Work," by L. E. Gray; "The New Water Supply for Atlanta, Ga.," by W. G. Richards; "Particulars in which Municipal Officers should Protect the Municipal Corporation in Granting Water-Works Franchises to Private Water Companies," by J. Nelson Tubbs. On May 18 the papers will be as follows: "Reservoir Dams," by W. B. Rider; "Distribution Mains and Fire Service," by J. T. Fanning; "The Kansas City Case," by B. F. Jones; "Protection of Exposed Water Pipes Crossing Bridges;" by S. E. Babcock; Some of the Circumstances which Affect a Water Supply," by Geo. W. Rafter; "Case of Contamination of a Water Supply with Sulphuric Acid," by Wm. P. Mason; "A Few Simple Suggestions as to Water and Water Supplies, their Use and Abuse," by C. Monjeau; "Water Pressure and Water Distribution," by Peter Milne. On the morning of May 19 there will be a paper on "The Water Supply of New Orleans," by A. L. Metz, and Mr. Chas. B. Brush will present some "Water-Works Notes." These papers will be followed by volunteer papers and a question box. The afternoon session will be devoted to business.

The usual social features and excursions have not been forgotten by the Committee on Local Arrangements. On Tuesday evening, May 17, there will be a reception at the Metropolitan Hotel by city officials and prominent citizens. Wednesday evening, May 18, there will be a theater party under the direction of the Local Committee. Thursday evening, May 19, is free. On Friday, May 20, there will be an all-day excursion to the Ridgewood pumping station and Prospect Hill reservoir, to Prospect Park and Greenwood Cemetery, with lunch at the Montauk Club, all in Brooklyn. On Saturday, May 21, there will be an all-day steamboat excursion to the Brooklyn Navy Yard and other points of interest, tendered by the National Meter Co., lunch being served en-route.

Ladies accompanying members and invited guests are invited to join in the two all-day excursions. On Tuesday, May 17, they will be escorted to various places of interest by the ladies of the Local Committee; and on Thursday afternoon, May 19, they will be asked to ride through Central Park.

Mr. H. W. Ayres, of Hartford, Conn., is Chairman of the Committee on General Arrangements, and Mr. Peter Milne is Chairman of the Committee on Local Arrangements. Prof. A. R. Leeds is Chairman of a standing Committee on Vegetable and Animal Growths Affecting Water Supplies, from which we believe, a report is expected. J. M. Diven, Elmira, N. Y., is President and J. H. Decker, 46 Liberty St., New York, is Secretary.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on May 4 the Secretary announced that the Society has agreed to take charge of the Civil Engineering Department of the Engineering Congress at the World's Columbian Exposition, and will undertake to prepare the program, secure papers, and make the arrangements for conducting the meetings. Two papers were presented, as noted last week. There was little discussion on Mr. Babb's paper on "The Hydrography of the Potomac Basin," but the Secretary referred to the importance of records of river gagings, etc. In the discussion on Mr. Dunham's paper on "A New Method of Tunnel Alinement," Mr. Nichols said there was difficulty in getting proper lights for such work, and that a satisfactory tunnel instrument has yet to be devised, and suggested that here is a good chance for electricians to get up something. He did not think it necessary to get exact work in such alinement. Mr. O'Rourke described a method used at the Haverstraw tunnel, with two suspended wires. Elevations were given on the bottom of plugs driven in the roof, and these plugs were used in alinement. Mr. Crowell referred to the advantage of keeping the instrument and line of sight out of the way of the work. He thought the throwing of a ray of light has been successfully managed in the electric search light, and that a suitable size may be adapted to tunnel work. He thought alinement could be given by means of holes drilled from the surface by a diamond drill to a given depth, which would be met by the headings; such an arrangement would be especially desirable for city work. Mr. North stated that a great deal of time and money might be wasted in getting exact work in tunnel alinement, as it is quite unnecessary to get the lines to meet closely. One member referred to a tunnel in the Cumberland slate formation, where the pressure caused the floor to rise violently, in some cases as much as 10 ins., and with sufficient force to upset a man. Mr. Collingwood referred to the advantages of the use of a templet, as in Mr. Dunham's method. In locating the anchor chains of the Brooklyn Bridge, which are vertical at the end, and then describe a vertical curve of 46 ft. radius, it was very important to have them exactly correct, in order to meet the ends of the cables at the proper point, and in this case he used a templet with very successful results.

The following is from a bulletin dated May 12: At the meeting on May 18, the paper for the evening will be on "Hot Tests for Determining Change of Volume in Portland Cement," by W. W. Maclay. The author states that ordinary tests give little information as to the change of volume in Portland cement due to the presence of free lime or other cause, such as insufficient burning; but that the hot test will give quick and satisfactory results. He describes the method of test now pursued by the Department of Docks in New York. Steam of the temperature of about 200° F. is used, the cement pats being exposed for various periods, and then to water of 200°; others of the same mixing being treated in the ordinary ways. He gives various tables of the results reached. He does not claim the method to be infallible, but urges that a cement which fails under the test is subject to grave suspicion. He criticises the "German Amended Rules," published in July last, as not always detecting inferior cements, and thinks also that the chemical method of determining the amount of free lime present in a cement is unreliable. The similarity between the effect of sea water and of hot tests on cement is pointed out; also the amount of rise of temperature in a cement when water is added. Quotations are given from several foreign authorities as to the usefulness of hot tests, and of the relative value of the hot and cold methods.

At the meeting on June 1, a paper will be read on "Wind Bracing in High Buildings," by H. H. Quimby.

WESTERN RAILWAY CLUB.—At the meeting on April 19 amendments to the rules of interchange were discussed. Mr. J. N. Barr submitted the following revised schedule of hours of labor to be charged for in various items of repairs of foreign cars:

Piece replaced.	Hours charged.
1 Draft sill	36
2 Draft sills	45
2 Intermediate sills	40
1 Intermediate and 1 draft sill	42
2 Intermediate and 2 draft sills	52
1 Intermediate sill	22
1 Side or intermediate sill spliced	13
1 End sill	23
1 Draft timber	C
2 Draft timbers (on same end)	10
1 Cross tie timber	8
1 End post	6
2 End posts (on same end)	9
1 Corner or side post	8
1 Swing bolster	6
1 Swing plank	5
1 End plate	18
1 Draw bar	2
1 Door stop side	2

Sheeting, lining and roofing, 2 cts. per sq. ft.; flooring, 1 ct. per sq. ft.; paint and nails, ¾ ct. per sq. ft.

These figures were approved by vote after a discussion, in which the fact was brought out that railways can, as a rule, repair their own cars, built to regular standards, more cheaply than another company can do the same work. It is also true that some cars are much more expensive to repair than others.

The proposal to discontinue carding for old defects was brought up and much difference of opinion was developed. It was generally agreed that the increase of carding was a serious evil. Many members, however, thought that cracked sills should be carded for in any event. It was finally voted by a small majority that a rule should be inserted to the effect that old defects shall not be carded for, except by the owner of the car.

The question of making partial repairs on a bad order card was discussed at length. Mr. Schroyer moved that where repairs must be made the original card should be removed, and all parts not repaired should be crossed off and the bill rendered on them. The company doing the work should place a card on the car against the original parties for repairs still remaining and notify them of it. When put to vote the motion was lost.

Mr. Rhodes called attention to the fact that some new heavy cars are being built with handbrakes on only one truck. He proposed to add to the defects for which cars may be refused in interchange the following "Cars of 40,000 lbs. capacity or over, which do not have brakes on both trucks." The motion was carried.

Mr. Forsythe spoke of the existing rules concerning the strength of drawbar attachments, which omit to specify anything concerning their size. He had recently taken some tail bolts out of foreign cars which were 1½ in. or 1⅝ in. in diameter, secured by a key. Some of these keys had broken at 40,000 lbs., and some of the bolts had broken at 50,000 to 60,000 lbs. A 1¾-in. bolt with a key will not stand much over 70,000 lbs. He therefore proposed that a clause should be added to Rule 3, providing for the rejection of cars of 40,000 lbs. or less with tail bolts less than 1¾ in., or heavier cars with tail bolts less than 2 ins. diameter. This motion was carried after considerable discussion in which the objection was made that small cars ought to have as heavy draft gear as large cars, and the fact was brought out that the yoke is superior to the tail bolt as a draw-bar fastening.

A motion was also carried that the rules should require duplicate cards to be issued to replace lost or illegible cards.

COMING TECHNICAL MEETINGS.

TECHNICAL SOCIETY OF NEW YORK.
May 14. 194 Third Ave. Secy., H. Schreiter.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
May 14. At Roanoke. Secy., J. B. Schick, Roanoke, Va.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 16 to 20. San Francisco, Cal. Secy., F. R. Hutton, 12 W. 31st St., New York.
WESTERN RAILWAY CLUB.
May 17. Rookery Building, Chicago. Secy., W. H. Marshall.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
May 17. Secy., E. N. Clark, Pittsburg, Pa.
AMERICAN WATER-WORKS ASSOCIATION.
May 17 to 20. Metropolitan Hotel, New York. Secy., J. H. Decker, East Orange, N. J.
BOSTON SOCIETY OF CIVIL ENGINEERS.
May 18. Secy., S. E. Tinkham, City Hall.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
May 18. Secy., F. Collingwood; 127 East 23d St., New York.
June 8. Annual Convention. Old Point Comfort, Va.
ENGINEERS' CLUB OF ST. LOUIS.
May 18. Secy., Arthur Thacher, Odd Fellows' Building.
ENGINEERS' CLUB OF CINCINNATI.
May 19. Secy., J. F. Wilson.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
May 19. Secy., T. G. Philfeldt, 118 Adams St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
May 19. At Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
NEW YORK RAILROAD CLUB.
May 19. At 12 W. 31st St. Secy., H. G. Prout, 73 Broadway.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
May 19. Secy., C. H. McLeod, Montreal, P. Q.
MONTANA SOCIETY OF CIVIL ENGINEERS.
May 21. Secy., F. D. Jones, Helena.
ENGINEERS' CLUB OF PHILADELPHIA.
May 21. 1122 Girard St. Secy., J. C. Trautwine.
CENTRAL RAILWAY CLUB OF BUFFALO.
May 25. Secy., Jas. Macbeth.
WESTERN SOCIETY OF ENGINEERS.
June 1. Secy., J. W. Weston, 280 La Salle St., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
June 2. Public Library Bldg. Secy., F. W. Cappelen.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
June 3. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
June 3. Secy., O. von Geldern, 519 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
June 4. Secy., P. Valentine, At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
NORTHWEST RAILROAD CLUB.
June 4. Union Station, St. Paul.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
June 6. Secy., C. L. Annan.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
June 6, 7. Grand Pacific Hotel, Chicago. Secy., E. W. Pope New York.
NEW ENGLAND WATER-WORKS ASSOCIATION.
June 8, 9, 10. Holyoke, Mass. Secy., R. C. P. Coggeshall, New Bedford, Mass.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
June 9. Secy., Edward Mead, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTHWEST.
June 9. Secy., O. H. Landreth, Nashville, Tenn.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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VOL. XXVII. THURSDAY, MAY 12, 1892.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

SUBSCRIPTION RATES: one year, $5.00; 6 months $2.50; 4 months, $2.00; single copies, 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses. No club rates allowed.

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ADVERTISING RATES, 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The program issued for the annual meeting of the American Water-Works Association, which meeting will be held in this city May 17 to 20, is a more than usually attractive one, as will be seen by referring to an abstract of it which appears in this issue under "Society Proceedings." The authors of the several papers are not only well known in water-works circles, but many of them are engineers of national or even international reputation. The subjects of the papers, it is pleasant to note, are none of them so hackneyed as many of those on earlier programs, there having been some tendency to thresh old straw at some past meetings.

As we have said in relation to previous conventions, every water-works official who is really interested in his work makes a mistake if he does not attend this meeting, and the water boards and companies which do not do their part in making it possible for engineers, superintendents and secretaries or registrars to attend make an even greater mistake. In fact, members of water boards and directors of companies would do well to be present at such conventions in larger numbers, and would many of them be able to "direct" to much better advantage if they did so.

The two rival water companies at Denver, Colo., are now in the midst of a rate war. One company is furnishing water free, refunding advance rentals, and the other company is giving receipts for six months upon payment of 25 per cent. of its schedule prices. About four years ago there was a split in the Denver Water Co., now the American Water-Works Co., which finally resulted in the formation of the Citizens' Water Co. The Citizens' Water Co. is now supplying part of Denver, and both it and the old company are struggling for the supremacy. The American Water-Works Co. is in the hands of a receiver, on account of fresh internal troubles, we believe, and the Citizens' Water Co., it is claimed by City Attorney Williams, is using the streets of Denver without a franchise. Whatever the outcome of this struggle, the people will finally be asked to pay its cost. Consolidation or a division of territory will undoubtedly result at Denver, as it has in the case of gas company wars in many cities. The rates at Denver will eventually be restored to a paying basis and will include returns on wasted capital, or, in case of consolidation, on an unduly large capitalization. Of 28 cities in the United States with a population of over 100,000 by the last census there are practically but six supplied by private companies. Chicago, Brooklyn and Pittsburg have, in addition, small portions of their territory so supplied. Of the 22 cities with more than 100,000 inhabitants now owning their water-works the supply in 10 was formerly furnished by companies. Denver will probably follow the example of these latter cities eventually, and adopt city ownership, although it may not do so for many years to come.

Mr. L. S. Coffin, whose missionary work in behalf of automatic couplers and power brakes, as the representative of the Brotherhood of Railway Brakemen, is well known, has brought a rather serious charge against the owners of the Gould railways. In our statistics of the progress in this important reform, published March 28, 1891, we noted the fact that the Gould railways had done practically nothing toward the introduction of either air brakes or M. C. B. couplers. Mr. Coffin charges that this is not due to apathy or to an honest disbelief in the merits of either the M. C. B. coupler or the air brake. He states that when he called on Mr. Geo. Gould to learn the reason of the apparent indifference of the roads under the Gould control to these reforms, Mr. Gould brought his fist down on the table with a thud and declared that the Gould roads would never spend a dollar for safety appliances until the Western states repealed their oppressive railway laws. If the railway employees want these appliances, said he, they must exert their influence to have these laws repealed.

To say the least, this was a highly impolitic utterance. To what extent the railway laws of the Western states are unjust or oppressive is a disputed matter; but granting that they work injustice to the Gould properties, the railway employees are not responsible for the passage of the laws, and neither in law nor equity is the neglect to provide for the safety of employees justified on the plea that they have not exerted their political influence to favor the employer.

It is of course true that safety appliances cost money, and there are many poor railway companies, especially in the South, which have delayed introduction of safe brakes and couplers on account of poverty. When oppressive railway legislation reduces income too far, retrenchment in even necessary economies may be essential. We do not understand, however, that the Gould roads are so near bankruptcy that they might not at some time during the past three years have taken at least the preliminary steps in this reform.

In the attempt to "get even" with the granger legislators, Mr. Gould seems to overlook the fact that the investment in the so-called safety appliances is a paying one for the railways, quite apart from the saving of employees' lives and limbs. He is also overlooking the drift of opinion and practice among railway officers, together with such statements as that recently made by the president of the American Railway Association that the time is not far distant when the leading railways will refuse to receive in interchange cars not fitted with M. C. B. couplers.

Finally, and what is perhaps most important of all, such unguarded expressions as that of Mr. Gould greatly prejudice both the public and the railway employees against the railway interests. The newspapers are already quoting Mr. Coffin's speech with the expressive headline "Railway Men Be Damned." We venture to say that Mr. Gould's remark will do much more to help than to hinder granger legislation; and that, while it may not cause a strike, it will awaken a general resentment which will give plenty of backbone to the next strike that occurs on the Gould roads.

In our issues of Oct. 24, Nov. 19, and Dec. 5, 1891, we gave sundry reports in regard to certain cattle-guard tests at Indianapolis on Oct. 13, 1891. The reports, while not entirely consistent with each other, appeared to be authoritative and accurate. From that day to this dispute has not ceased as to what were the real facts, and as to whether those facts were the result of fair conditions. A correspondent in another column brings a new and serious charge in regard to the good faith of some of these alleged statements of fact, and as to the use which is now being made of them. We have no means of determining the truth of these charges. The statements were submitted to us for publication in apparent good faith, bore every outward evidence of being made in good faith, and of course were published. But the facts make this clear, at least, that there was great lack of previous preparation to observe and record the results of the tests in an authoritative way, if nothing else, and hence that the only fair course is to throw the tests out bodily as inconclusive. It is very desirable that there should be an entirely new set of tests, made more carefully, if not also more fairly, than these were. For ourselves, we have long ago given up the effort to determine "what is truth" as to these tests. The conflict of evidence is too great. We have no opinion except that the importance which the tests were to assume was not foreseen, the precautions necessary to make them fair "record" tests not taken, and the conditions themselves probably not just what they should have been. Our idea of a perfectly fair test would be to inclose a lane say 25 ft. wide, covered with coarse gravel, between rows of guards to be tested, each guard being represented in duplicate on each side of the lane; the cattle to be kept in outside pens until the time of test; to be moderately hungry but not starved; to be habitual "rustlers" if possible, and to be tempted across by a liberal and continuous display of green fodder, preferably rich growing grass or corn, but not to be driven in so thick as to crowd each other across. All guards to be crossed by two or more cattle before they were fenced off, and to stand open for an hour at least. All guards sustaining this test for some hours to be classed as good. Our impression is that not one only, but several of the guards on the market would stand this test.

CHICAGO'S STANDING DANGER OF WATER POLLUTION.

In our issue of April 21, 1892, we gave in full the startling records of increase in typhoid fever at Chicago, due to pollution of its water supply. By statistics covering 22 years' experience at Chicago, Philadelphia, New York and Boston was made unmistakably clear, it seemed to us, that Chicago (and also Philadelphia) had suffered greatly from this cause during all these years, but in the last two years there had been an especial and marked increase in the danger, which showed no signs of abating.

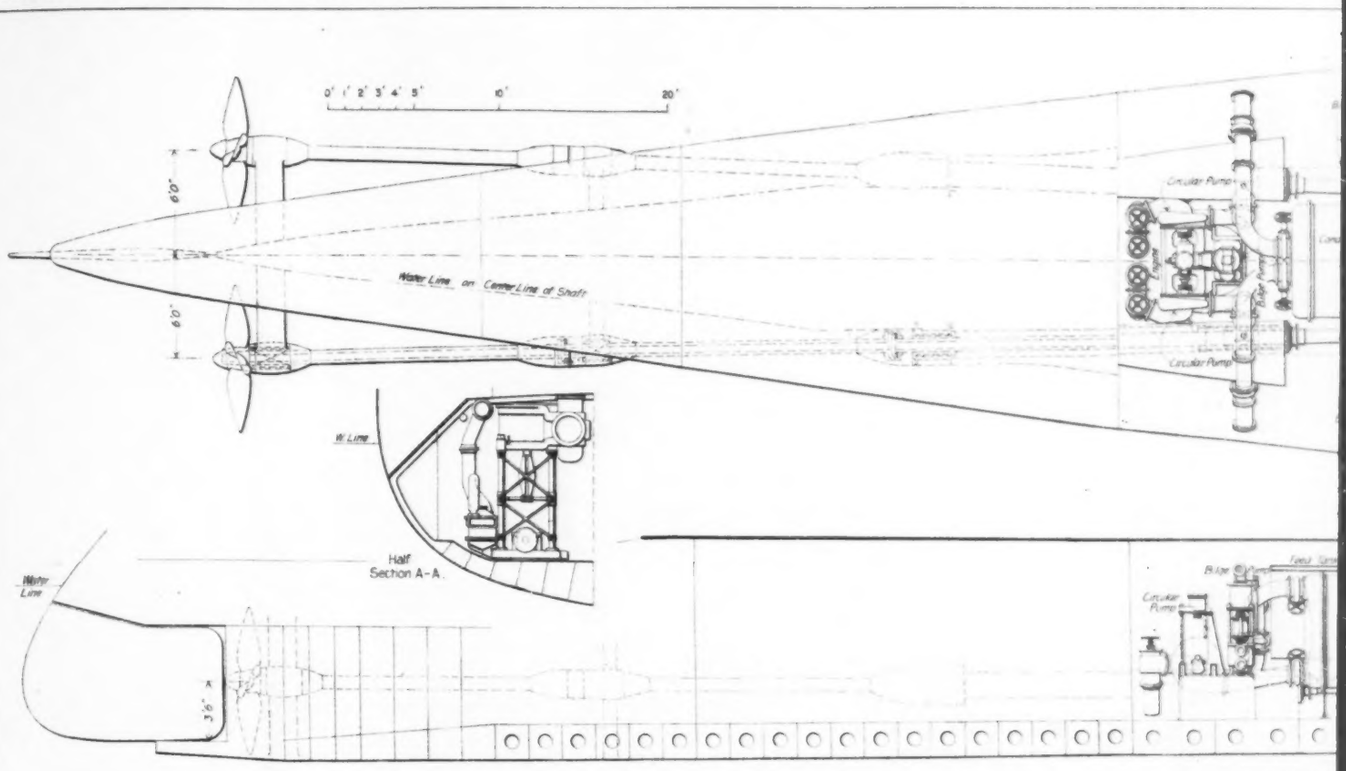
Events since that date are emphasizing this danger. It is becoming increasingly clear that Chicago will not be free from danger of a sewage-polluted water supply and consequent epidemics of typhoid fever while it depends upon Lake Michigan for water, and leaves possible the shameful and criminal pollution of the lake which is described in the press dispatch given below. This dispatch was dated Chicago, May 6, and appeared in the New York "Tribune" of May 7. Its statements are verified by the Chicago papers, as will be seen further on. It reads as follows:

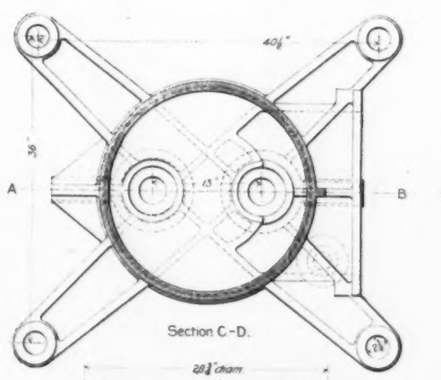
There is grave danger that the immense amount of sewage now being discharged into the lake on account of the recent heavy rains will pollute the city's water supply. The officials admit the danger, although they hope that their worst fears will not be realized. The river was still high to-day, higher than at any time since 1883, when it was asserted by many people that the sewage reached the two-mile crib and got into the people's drinking water. A strong current was sweeping into the lake to-day, carrying with it all the refuse from the stock yards, for the Bridgeport pumping works are idle. The blackened and polluted water could be seen far out in the lake, but Captain McKee, the crib-keeper, telephoned into the City Engineer's office that the water around the crib was still pure and undefiled. The enforced idleness of the Bridgeport pumps greatly increases the danger of the situation, but the Engineer's Department is powerless to change the state of affairs. The pumps ordinarily lift about 45,000 gallons of water from the river into the canal each minute, but the canal is full to overflowing, and it is impossible for the pumps to control the current setting into the river. This current is therefore drawing all the stock yards' sewage toward the lake at the rate of four miles an hour. This condition of affairs must continue until the flood subsides and the pumps can be started again.

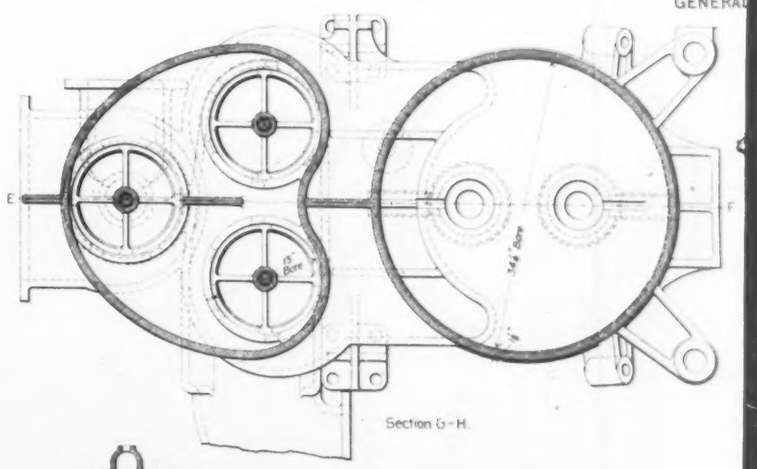
The Chicago "Tribune" of May 6 has the following, which sets forth the situation in more detail:

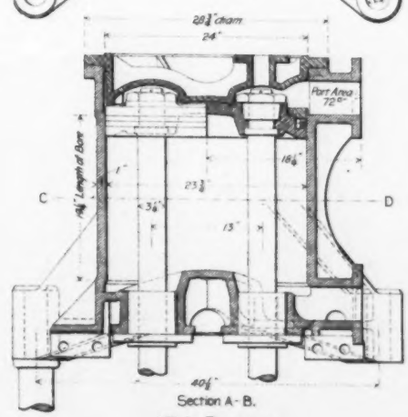
The storm of yesterday morning and the night before is apt to have a bad effect on Chicago's drinking water. It has made the current in the Chicago River stronger than it has been for years, has forced the waters of the Des Plaines River over the Ogden dam, made it necessary to shut down the Canalport pumping station, and has swept refuse of all sorts out into the lake.

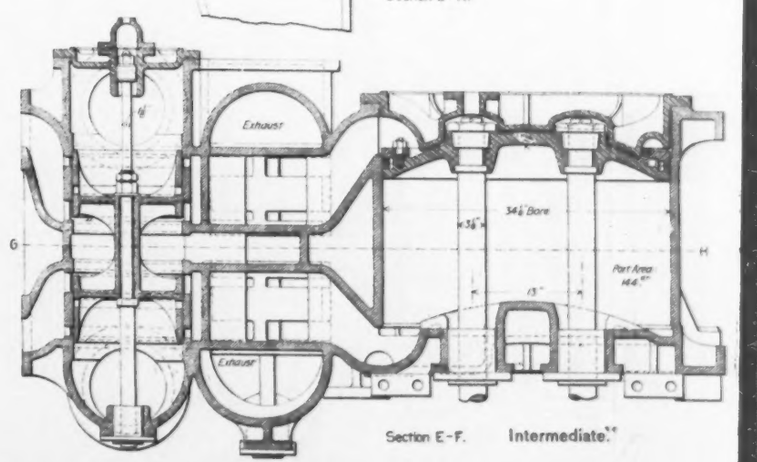
Along the lake shore, from the city line on the north to the southern limits, lies a mass of greenish-black water—yesterday's discharge from the river. The sewage is held there by a stiff northeast gale. If the wind holds in that quarter till the impurities are oxidised little damage to drinking water will ensue, and



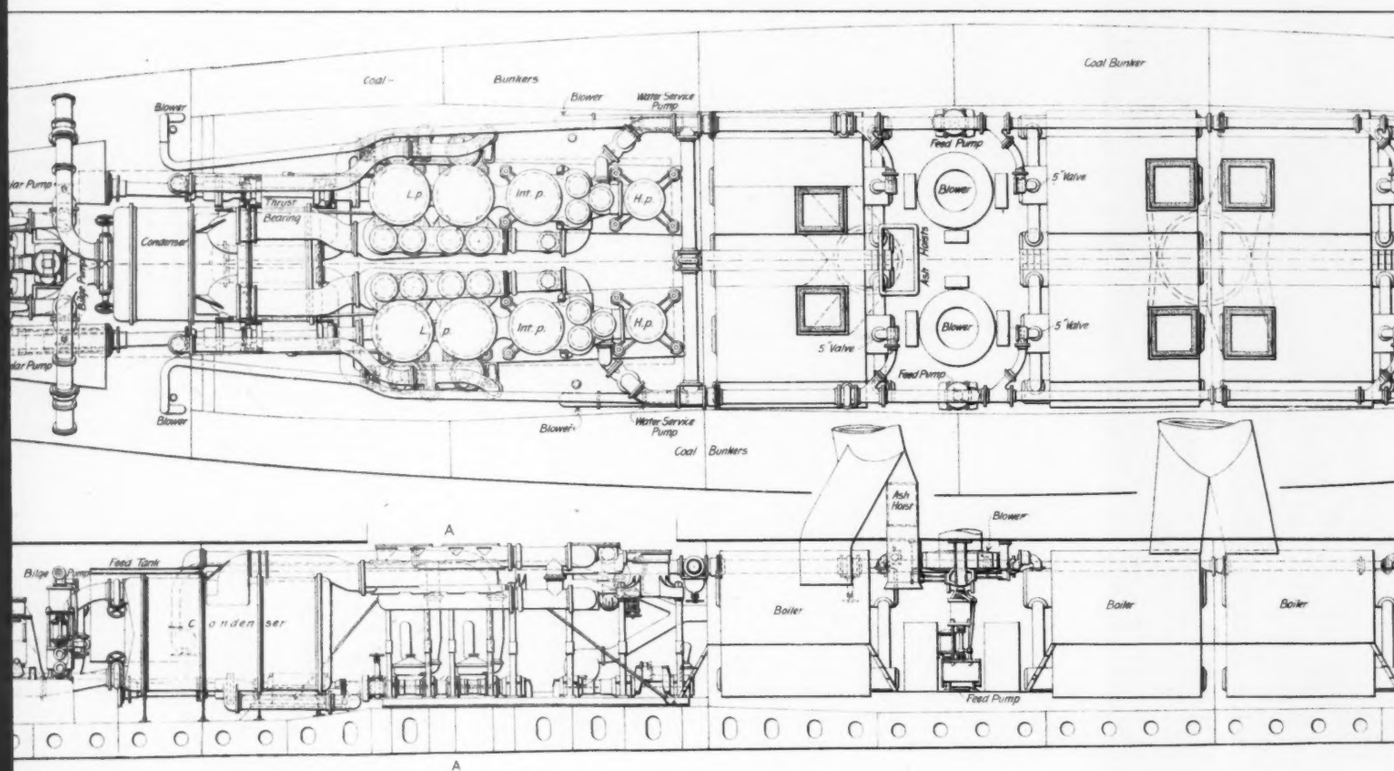








PLANS AND SECTIONS OF ENGINE CYLINDERS



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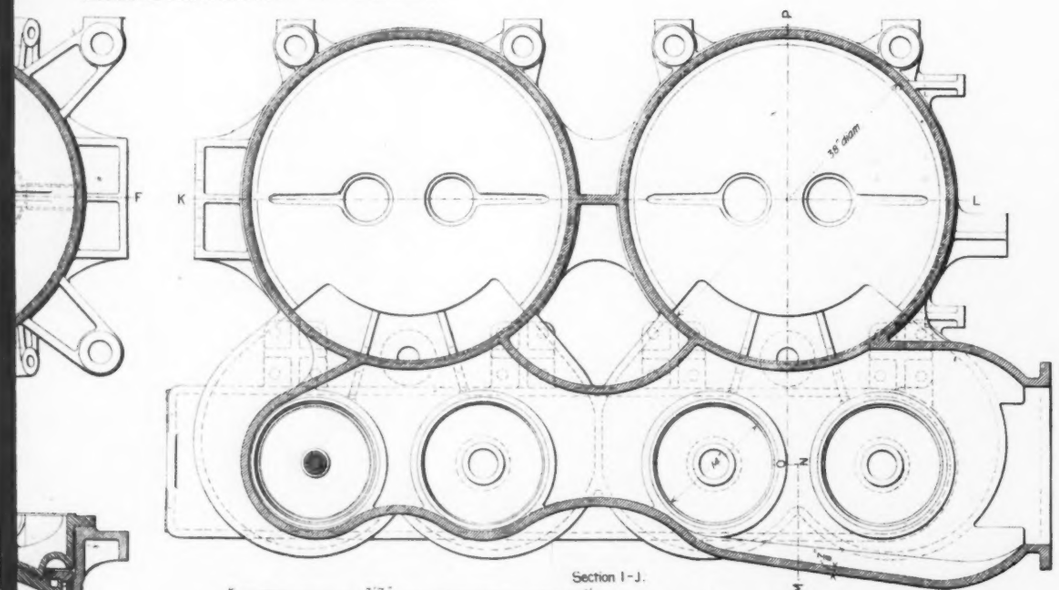
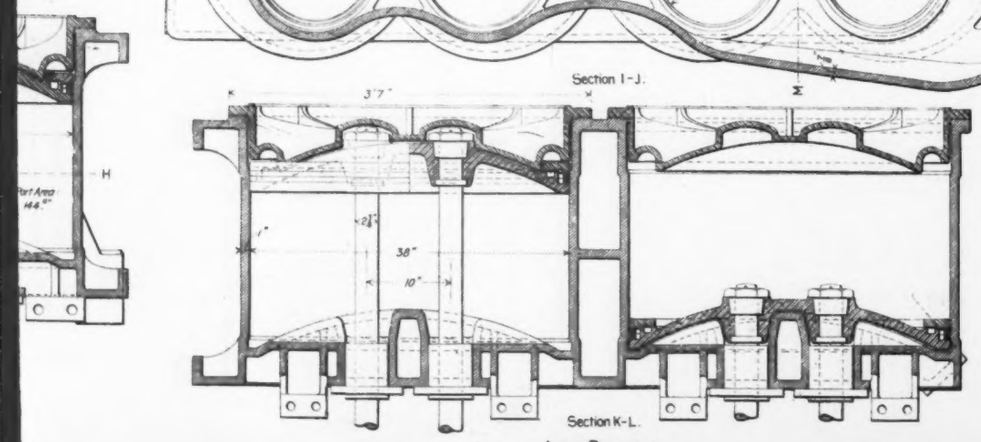
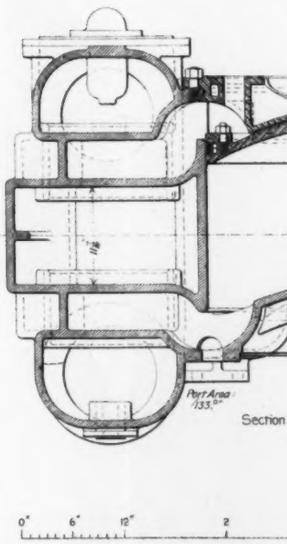




Low Pressure.



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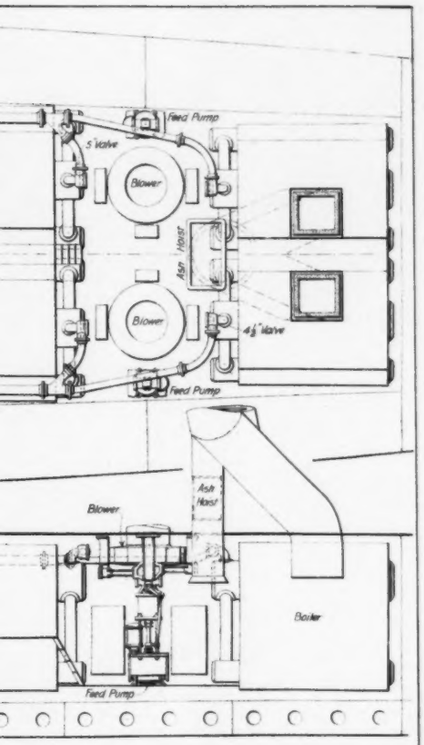

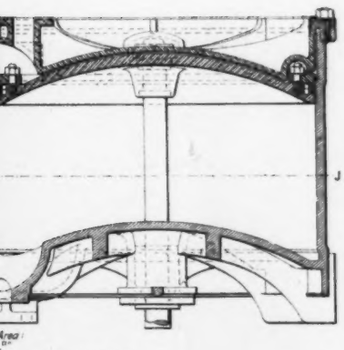

Section M,N,O,P.

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' DESIGNED FOR SSEL FOR U. S. NAVY OF STEAM ENGINEERING.

Displacement of Hull, 750 tons.
od, 23 Knots.

CHAS. HART & BOND, LITH., 90 VESEY ST., N. Y.

the only noticeable effect of the storm will be the cloudiness due to sand and clay. But should the wind shift the sewage now hugging the shore will be drifted into the open lake. Then nothing can prevent its finding its way to the hydrants and faucets of the city.

It will be noticed that the quotation states that the sewage extended along the whole city front. In 1890 an average of 28,000,000 gallons per day was pumped at the Lake View station through intakes extending from 1,100 to 2,000 ft. into the lake. By July it is expected that water for the Lake View pumps can be drawn through a temporary crib and the new Lake View tunnel from a point about 6,000 ft. out. At present, so far as we can ascertain, the water must be drawn from these short intakes, and the supply for one section of the city must therefore be badly polluted, if the statement just referred to in the above quotation be true.

The menace to the main supply is apparent. In way of explanation it should be said that the Chicago Drainage Board took the opportunity afforded last week by the flooded rivers to study some of the problems before them, passing through the Chicago River and into the lake. The "Tribune's" report of the trip is as follows:

The tug Viola first steamed down the river and out into the lake, the Commissioners noticing the appearance of the water as they passed through it. The water was murky most of the way and it was only on nearing the outer crib that the blue water line became apparent. The polluted stream from the river had worked its way out that far. It also had carried some dead animals with it, including the decaying carcass of a horse, which was tossed about amid the whitecaps not far inside the line of the crib. The presence of this and the carcasses of dogs, cats and other animals frequently seen floating in the river and drifting toward the lake suggested to President Wenter that the city ought to employ at least two river scavengers, one for each branch, to pick up these dead animals before they should reach the source of our water supply.

While the water at the crib looked clear, some of the Commissioners thought it was far from being entirely pure, and believed that as the full overflow from the valley of the Des Plaines and other points came along the yellow stream, surcharged with city sewage and country impurities, would force itself farther into the lake and beyond the crib.

When the party rounded the intake crib they returned to the Chicago River and up the North Branch. Here, quoting again: "From each bank the big sewers poured foaming torrents."

At this point it may be stated that on Jan. 1, 1891, Chicago had 785 miles of sewers, discharging either directly into Lake Michigan or indirectly through the Chicago and Calumet rivers. Many of the sewers are necessarily of low grade, and as nearly all the storm water enters the sewers the heavy rain which caused the recent floods must have given them an unusual flushing, and thus added to the filthy volume which has been finding its way into the lake.

Regarding the inability of the Bridgeport pumps to keep the lake from becoming contaminated, Mr. L. E. Cooley, C. E., one of the drainage trustees who made the trip referred to above, is quoted as saying: "In such a flood as this the utter inadequacy and practical uselessness of pumping works at Bridgeport or elsewhere becomes plain."

For the benefit of those who are unfamiliar with the situation it may be stated that in order to remove as much sewage as possible from the Chicago River, and thus also from its branches, and at the same time to give an inland current to the Illinois & Michigan Canal and prevent stagnation, an immense pumping station with a nominal capacity of 50,000 cu. ft. per minute, or about 70,000,000 cu. ft. per day, has been built to pump from the river into the canal. In times of heavy rains the pumping station, it appears, is unable to remove as much water from the river as there is combined sewage and storm water entering it. In addition, as in the present case, the Des Plaines River, in times of heavy precipitation discharges into the Chicago River, as does the Illinois & Michigan Canal, so that altogether there is one grand rush of water to the lake through the north and south branches of the Chicago River, this being accelerated by the overflow of the Des Plaines and the canal. This explains why the pumps were stopped last week.

The South Branch, it is a disgrace to Chicago and civilization to say, receives the sewage from the stock-yards.

The experiences of the present flood at Chicago have proved beyond all doubt, if any doubt could exist after the showing made in our issue of April 21: (1) So long as sewage discharges into the Chicago River and its branches, and this river discharges, or may at times discharge, into Lake Michigan, no one of the water-works intakes yet in use is beyond the reach of the sewage-laden current. (2) Water so far out as the four-mile intake may become directly contaminated by sewage under favoring conditions, especially if the following quotation from the Chicago "Inter-Ocean" of May 7 be true, and it seems probable that it is:

The City Engineers are watching with much interest the general trend of the sewage-laden river as it moves into the lake. The line of demarcation between the polluted water and the pure was yesterday nearer the four-mile tunnel than the old two-mile tunnel station off Chicago Ave. The four-mile intake lies off Twelfth St., nearly two miles south of the old bridge, and with the wind in the northeast, as it frequently is, the effect on the lake current seems to be such that impurities from the river are likely to reach the new intake about as soon as the old.

It is evident that by the time such a sewage stream would reach the four-mile crib much of its suspended matter would have sunk to the bottom. Yet, under present conditions, and during floods like the one just experienced, it is not one day's sewage from 400,000 to 600,000 people that is flushed into the lake with a velocity of four miles an hour, possibly reinforced by the winds, but it is the sewage and filth of several days that flows out in an easily distinguishable body.

Moreover, the sewage that sinks to the bottom does not of necessity remain there until it and its accompanying bacteria, typhoid or otherwise, become harmless. Winds and waves may carry it even to the four-mile intake after settlement to the bottom.

Although the present efforts to secure a supply four miles from the shore for the main city and 10,000 ft. out for Lake View are highly commendable, Chicago cannot with safety rely upon these measures. Nor is it doing so. The Sanitary District of Chicago, through its trustees, is taking steps to construct a drainage canal which shall continually carry the city's sewage away from the lake, plentifully diluting it with water and finally discharging it into the Illinois River.

But these two questions arise: (1) Will the proposed canal be of any service before and during the World's Columbian Exposition in 1893, and (2) when completed, will its capacity be adequate to such a task as would be before it now were it already completed?

To the first question there seems to be but one answer, and that is, emphatically, no. The bids for constructing the first section of the canal, from Joliet to Willow Springs, are not to be opened until June 8, and work need not be started before August. The estimates for this section include the removal of about 11,500,000 cu. yds. of rock, 5,000,000 cu. yds. of earth, the building of 287,000 cu. yds. of dry rubble walls, and the placing of 244,000 sq. yds. of slope paving. As the bids are to be on different plans, and the plan to be carried out will not be selected until the bids are tabulated and compared, it is evident that work on these contracts, under the most favorable circumstances, will not be started for some time.

In answer to the second question, the president of the Drainage Trustees, Mr. Frank Wenter, is reported by the Chicago papers as saying, while viewing the flood, that "the capacity of the drainage canal might better be 1,000,000 ft. than 600,000," while Mr. L. E. Cooley, C. E., one of the Drainage Trustees, is reported as saying "that in times of flood like this nothing less than a 1,200,000-ft. channel would suffice," both gentlemen meaning cubic feet per minute.

We understand that an effort is being made to have the law under which the drainage canal is to be built so amended that its capacity will be only 300,000 cu. ft. per minute. This would certainly be a great mistake, for the canal will not only help solve Chicago's sanitary problem, it will also help to prevent floods in the Des Plaines and Illinois River Valleys, and if the hopes of many of its warmest advocates are realized, it will be an important step toward connecting Chicago with the Mississippi River. An immense volume of water is needed in any case to properly dilute the sewage of Chicago's rapidly increasing population.

Opponents to a drainage canal with a capacity of more than 300,000 cu. ft. per minute urge that if a canal with a capacity of 1,000,000 or 1,200,000 cu. ft. per minute would not carry the floods of the Des Plaines River, then it is useless to provide a capacity of 600,000 cu. ft., since at times the Des Plaines will find its way into the lake through the Chicago River. It is urged that if a 300,000-ft. channel had been in operation during the past few months there would have been no accumulation of sewage to have passed into the lake last week. But the daily discharge of the city's sewers and the flushing caused by the heavy rains would, most of it, have passed into the lake with a 300,000-ft. channel, while even with the larger channel some of it must still go into the lake during any flood which is beyond the capacity of the banks of the Des Plaines River and such a canal as may be provided.

The only permanently safe way is to exclude all sewage from the lake, and the sooner Chicago realizes this the better it will be for its permanent welfare.

The one question at Chicago which should take precedence of all others is, what can be done to prevent such risks during the World's Columbian Exposition as have been set forth above. The city will be crowded in 1893, thus aggravating the usual tendencies to contract sickness and disease. The consumption of water will largely increase and with it the amount of sewage. Some of this sewage will go into the lake anyway, because the present outlets are there and cannot be changed before that time, so far as now appears. The remaining part of the sewage may go into the lake at any time when the lake is low, the rivers high, or the wind strong and lakeward at the mouth of the river. The sewage permanently discharging into the lake is always liable to contaminate the water supply of a part of the city to some extent. If the four-mile tunnel and intake crib and all accessories are in successful operation in 1893, then it would seem that all the water from this source will be of good quality under favorable circumstances, provided the Bridgeport pumps keep the daily flow of sewage out of the lake. But at times the Bridgeport pumps are unable to keep the sewage from the lake, and they must be idle when the lake is 4 ft. above datum, which point was exceeded by 2 ft. last week. At such times the chances for impure water, even at the four-mile intake, seem great.

Sewage-polluted water, as set forth at length in our issue of April 21, 1892, and as shown in our issue of Feb. 27, 1892, has without doubt caused thousands of unnecessary deaths in Chicago in the past. The experience of Philadelphia in 1876 during the Centennial was such that no one wishes to see it repeated at Chicago in 1893.

Chicago is doing much to ward off danger from its citizens and guests in 1893, but could it not do more? Could it not, for instance, compel the stock-yards and slaughter-houses to purify their sewage before discharging it into the sewers? Could it not provide means of flushing, where most needed, its 800 miles of sewers, so that when a flood comes and the sewage is likely to go into the lake, the grand flushing of the accumulations of weeks or months may not be added to the water supply? Can it not determine accurately, as there seems to be some doubt about it, just how much may be pumped daily from the Chicago River through the present canal without flooding it, and then increase the pumping capacity to that amount? At least it can, and doubtless will, see that the canal pumps do not remain idle, as they have in past years, while sewage accumulates in the stagnant rivers to be swept into the lake at the first opportunity.

As America's representative city in 1893, Chicago should make sure, if it be possible, that its water supply at least be pure. Otherwise, four centuries of American progress since the advent of Columbus will contrast strangely with a water supply polluted as Chicago's might have been last week, and may easily be in 1893.

The practice cruiser "Bancroft" was launched from the yards of the Samuel L. Moore & Sons Co., at Elizabethport, N. J., on April 30. The vessel is designed for use in the instruction of the naval cadets at the U. S. Naval Academy, but her armament also fits her for efficient service in case of war. Her dimensions are: Length on water line, 187½ ft.; beam, 32 ft.; draft, 11½ ft.; displacement, 838 tons; maximum I. HP., 1,300; speed, 13 knots per hour. She is fitted with the usual type of engines driving twin screws. Her armament comprises four 4-in., two 6-pounder, two 3-pounder, and one 1-pounder, rapid firing guns, one 37 mm. revolving cannon and one Gatling gun. There are two torpedo tubes for launching automobile torpedoes. The contract price of the vessel was $250,000.

LETTERS TO THE EDITOR.

AUTOMATIC BRIQUETTE-MAKING MACHINES.

Sir: In 1887 you gave an excellent description of Dr. Bohme's automatic hammer for cement testing. Do you know of any in this country, or the address of the doctor in Germany? Do you know of any other automatic machine for packing briquette in cement testing? Yours truly, M. J. Butler.

Deseronto, April 30, 1892.

(Mr. S. Bent Russell, Principal Assistant Engineer St. Louis Water-Works, described one in these columns Jan. 3, 1891, in connection with a general description of the plant and results of their cement testing. We apprehend it is a better machine than the one described in 1887, but have made no careful comparison.—Ed.)

GRAVITY OR SWITCHBACK RAILWAYS.

Sir: Can you put me on the track of detailed information in respect to the construction of the gravity railways at Atlantic City and other pleasure resorts, either through publications or by giving the address of any engineer who has had charge of this kind of construction? J. M. O.

Denver, Colo., May 6, 1892.

(Our correspondent evidently refers to what are popularly known as switchback railways, but we do not know of any published details of their construction. The requirements for operation, in addition to those of strong construction of trestle, with good track and running gear to insure safety, are that a grade of at least 1 per cent. is required to keep the cars moving, and that the dips below that grade line should not exceed 20 ft., which will give a speed of about 24 miles per hour.—Ed.)

A BUSINESS-LIKE NOTICE.

Sir: I enclose a copy of a notice which is posted in the office of a leading surveyor not a thousand miles from here, which is bright and business-like, and may serve to enliven your columns. Perhaps, too, some of your subscribers, who may have suffered from people who want something for nothing, may think it worth imitating. Respectfully, T. P. Perkins.

Lynn, Mass., May 7, 1892.

KNOW ALL MEN BY THESE PRESENTS.

First, That it is our Specialty to Prepare and Sell Correct and Reliable Plans; not to exhibit them gratuitously.

Second, That the Valuable Information in our Books relative to Boundary Lines has been obtained by 20 years of investigation and labor.

Third, That our Time represents Bread and Butter.

Fourth, That we must acquire a competence for our declining years; therefore, while we are pleased to serve you, we expect Proper Compensation for all efforts in your behalf.

THE MANAGEMENT OF GOVERNMENT PUBLIC WORKS.

Sir: In your issue of Feb. 13 you ask: Why may not the plan of the Navy Department to ask for bids both on department plans and bidder's plans in letting out its work, be applied with modifications to our river and harbor work? I think the question comes at an opportune time, and should be pressed upon the attention of the entire people. The suggestions which you offer for its solution, seem to me to strike the keynote. The army engineers and the civil engineers both recognize the fact that the present state of affairs is unsatisfactory. It is useless for the army engineers to deny that the practice of hurrying them all over the United States, not giving them time to gather that practical experience at any one point that is absolutely necessary to the successful prosecution of the work at that point, is full of evil. The practice of rotation of office has its influence for good, in making our army engineers acquainted with all our rivers and harbors in case of war, but it seems to me that such acquaintance, unless very thorough, does not amount to much. Whatever the good of the practice, I think the evil predominates. I will say right here that I do not bring any indictment against the honesty or capability of the army engineers as a class. Take the system under which they struggle, and no class of civil engineers could bring about better, if as good, results as they have. They are so hedged about with red tape and army etiquette that I wonder they have time for any real engineering duties. They are a hard worked class, contrary to the general impression. The only time for rest seems to come when they are away on leave of absence (with permission from Washington). Their vouchers and pay rolls must be in just such and such a form; they must be in duplicate and exactly alike, or may be, months after they have been sent to Washington, they will be returned for explanation and change. A railway chief engineer would go wild and throw up his place, if so handicapped.

Looking at the question from the standpoint of the civilian assistants, we see a great deal of evil in their lot; but it is useless, however hard the present methods may bear on the "poor assistant," to appeal to Congress for help for them. They need help, to be sure; but it is against the spirit of our institutions to legislate in favor of classes. In any discussion of the question, to recite the hardships of the civilian assistants, as affecting them alone, in my opinion, does more harm than good. We must prove that the present system of management in our river and harbor work is fraught with disaster to the interests of the people. I think this can be done, and I hope you will urge the importance of the subject on the attention of all the technical societies. I will wager that a majority of the army engineers are in favor of a change and would welcome just such a one as you suggest.

Very truly yours, U. S. Assistant Engineer.

New Orleans, La., Feb. 23, 1892.

THE NATIONAL AND OTHER SURFACE CATTLE GUARDS.

Sir: An anonymous communication published in Engineering News of Oct. 24, 1891, is doing serious injury to our business. It assumes to describe a test of cattle guards made at Indianapolis, Ind., on Oct. 13, 1891, but is nothing more than a series of false statements and practically a wholesale condemnation of all cattle guards on the market. The injury is being done by the patentee of a new guard, a guard yet to be officially tested with other guards, who is using this communication by itself, separating it from the real facts as given in the official reports published in Engineering News of Nov. 21 and Dec. 5, 1891. And to give further force and weight to his arguments, he uses the high standing of your journal by crediting the communication to Engineering News. In the light of recent developments, and with the actual facts in view, it is fair to infer that this letter was written by an enemy for malicious purposes only, and in order that it might be pointed to, "at the proper time." To prove the truth of our statement, that this letter is wholly false, your readers are requested to read the official record referred to above. In this communication two statements are made which we wish again to refute: First, it is stated that the National Cattle Guard Co. had two guards in the test; this company actually had but one guard tested. Second, it is stated that the National was the first guard crossed; the fact is, it was the last guard crossed. See Engineering News of Dec. 5, 1891, page 532, near the bottom of second column. These are important differences in tests of this character; and we would further add that the National was crossed after an exhaustive test of 2 hours and 40 minutes.

It is most unfortunate that the high standing of your valuable journal should be used as an argument and aid to secure business by such questionable methods, and to injure the business of this company, as is being done. Should you not, on general equable principles (and from past experience, it is our belief that you aim to be just) have investigated the truth or falsity of this statement, which could not but do serious injury to all cattle guard manufacturers then in the field, especially when the writer sent it as, or wanted it to appear as, an anonymous communication? And should you not, since this was not done, and it is by your misplaced confidence in a correspondent that we are placed in the unpleasant position described, give your assistance, so far as is consistent, in righting this wrong and placing us in the true light before your readers?

Yours very truly, The National Surface Guard Co.

Chicago, May 7, 1892.

(Our correspondent's complaint is just. We have discussed the general question raised in this letter in a note on our editorial page. There can be no doubt that tests which are so extensively disputed as these are as to questions of fact cannot fairly be accepted as conclusive. As regards the "anonymous" communication to which our correspondent refers, it was not sent to us anonymously, of course, or it would not have been published at all, but it was published anonymously by request of the author, and we can only say that could we have foreseen that the statements in it would have been the subject of so much dispute, it would never have appeared except over the author's own name. The only fair thing now, so far as we can see, is to reject all the alleged results of these disputed tests as not proven. We have done so. We advise every one else to do so. There ought to be some new ones with more careful provisions for insuring an accurate and undisputed record.—Ed.)

NOTES AND QUERIES.

J. D. asks how much elevation to give the outside circle of a ½-mile regulation race track. Rules given in Engineering News of July 5 and Oct. 11, 1890, call for a slope of track on curves of 1 in 10 to 1 in 15, according to the radius of the curve.

THE EARLY HISTORY OF PORTLAND CEMENT MANUFACTURE.

From a handsome pamphlet recently issued by the American Cement Co., the following abstract is made regarding the rise and progress of this industry:

The first cement known to history is the Roman mixture of fat lime and puzzuolana, or volcanic dust. The resultant mortar had great hydraulic powers, and is still used by the people on the Mediterranean coast in large public works. In the days of Vitruvius and later writers the masonry of Europe generally was laid with a mortar made of fat lime and sand, which was mixed together and left in pits to slake for sometimes two or three years before use. The object of this long slaking was to thoroughly incorporate the lime and sand, and to form, as nearly as possible, silicate of lime. This method of mortar-making was disputed in the reign of Louis XIV. of France, and a rival school of builders advocated the use of hot and unslaked lime.

But it was not until 1759 that John Smeaton, while reconstructing the Eddystone lighthouse, solved the problem of securing a mortar that would withstand both the sea-water and the mechanical action of storms. After testing the various limestones of England, he established the principle that a limestone yielding, when dissolved in hydrochloric acid, a residue of from 15 to 25 per cent. of solids would, when mixed with sand, harden under water. This residue, mostly silica and alumina, practically represents the chemical constituents of Roman puzzuolana. As a result of Smeaton's discovery, search was made in England for a hydraulic limestone, resulting in the use of the liver-colored nodules of septaria, discovered by Parker in 1796. From these the first natural cement known to commerce was made by calcining in open kilns and grinding between millstones. This was sold under the name of Roman cement.

Sir C. W. Paisley, Vicat and other engineers and chemists followed after Smeaton and on broader lines. But the first man to practically produce what is now known as Portland cement was Joseph Aspdin, a bricklayer of Leeds, England. He took out a patent in 1824 for combining English chalks with clay from river beds, in fixed proportions, calcining this mixture in closed kilns and grinding the clinker thus produced. It was called Portland cement, because the resulting artificial stone closely resembled in color the well known "Portland" building stone of England. This was a wide departure from previous methods, and a really new rock was made containing known proportions of lime, silica and alumina, instead of using these ingredients as nature placed them in the rocks.

In the United States, natural cements were first made in "the forties" for the purpose of building the New York and Pennsylvania canals of that time. Cement rock, or argillaceous limestone, was found near Rondout, N. Y.; at Siegfried's Bridge, on the Lehigh River; on the Potomac, near Hancock and Cumberland, Md., and at Louisville, Ky. Excellent cement was made, and the industry has since grown to enormous proportions.

During this time the development of the Portland cement industry was going on in Europe, and by 1860 its use was well established in Belgium, France, Germany and Austria. Between 1860 and 1870 official testing stations were established in Germany, Austria and France, and similar establishments, conducted by well known engineers, grew up in England.

Portland cement first began to appear in the United States about 1865, but until 1876 the entire supply came from abroad. Mr. David O. Saylor, a farmer's boy of Lehigh County, Pa., had for some time been engaged in a small way in the manufacture of ordinary cement. His attention was called to the increasing importation of European cements, and he began experimenting upon the production of an equally good product in this country. Owing to the fact that the manufacture in Europe was carefully guarded, he had to work out his problem by individual effort. Finally, in 1878, after an experience that "hovered between prosperity and the sheriff," he succeeded, and with Mr. John W. Eckert, a graduate of Lehigh University, he established the first commercial and successful Portland cement works in America.

NEW YORK'S FIRST ATTEMPT TO SECURE A WATER SUPPLY.

One of the first evidences of an attempt by the city of New York to provide itself with a public water supply is shown by the accompanying reproductions of the two sides of a treasury water note issued by the city in accordance with an order dated Aug. 25, 1774.

New York was one of the 16 towns in the United States that had a public water supply at the beginning of the present century, but it was by no means first in the introduction of water nor did it have an adequate supply until the completion of the Croton aqueduct in 1842.

Boston alone, so far as the records go, enjoyed any approach to a public water supply during the seventeenth century, a company as early as 1652 bringing a gravity supply to a box or tank for domestic use and fire protection. Before the Manhattan Co., which now conducts the Manhattan Bank in New York, introduced water in 1799 ten other cities had already been more or less adequately supplied, Boston, as stated, being the earliest and Salem, Mass., in 1798, the latest.

In 1774 the Common Council accepted a proposal from Christopher Colles to dig a well or wells and construct a reservoir for a water supply, the water to be pumped from the well to the reservoir.

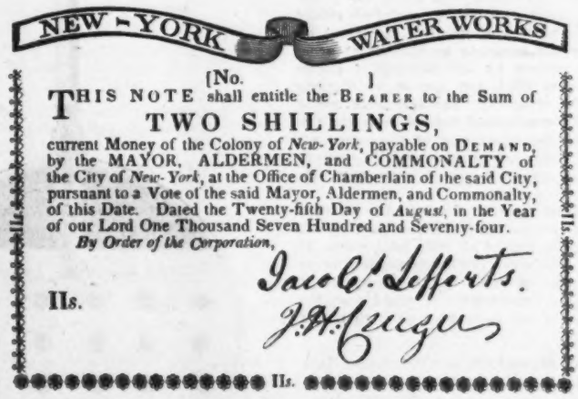
On Aug. 8, 1774, the Common Council ordered the purchase of land east of Broadway, between Pearl and White Sts., at £600, or about $2,800, per acre, at each side of the engine are two conventional fountains.

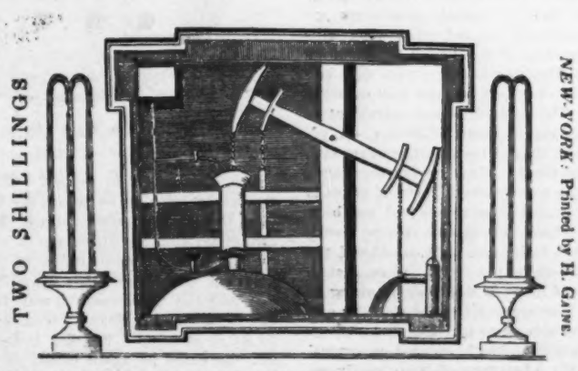
The land above mentioned was deeded to the city Oct. 8, 1774, by Augustus, Catherine and Frederick Van Cortland (a well known New York family name), £1,050, or about $5,000, being paid for 1¾ acres of land. The payment for this land was made in city bonds bearing 5 per cent. interest.

Aug. 2, 1775, additional notes of the denomination of one, two, four and eight shillings were ordered issued, the aggregate being £2,600, or about $12,600.

Just how far Mr. Colles carried the work of introducing water the account before us does not state. He sank one well and built a reservoir which, in Mr. King's "Memoir" mentioned above, was termed "spacious." Aside from the cost of the land, notes to the amount of about $24,000 were issued in 1774 and 1775 for the New York Water-Works, as they were called, which, with the price paid for the land, made $29,000 expended for this purpose.

The Revolutionary War seems to have put an end to this enterprise, and after it was over the work already done seems to have been ignored, as other schemes were at once taken into consideration.


NEW-YORK WATER WORKS
[No.]
THIS NOTE shall entitle the BEARER to the Sum of
TWO SHILLINGS,
current Money of the Colony of New-York, payable on DEMAND, by the MAYOR, ALDERMEN, and COMMONALTY of the City of New-York, at the Office of Chamberlain of the said City, pursuant to a Vote of the said Mayor, Aldermen, and Commonalty, of this Date. Dated the Twenty-fifth Day of August, in the Year of our Lord One Thousand Seven Hundred and Seventy-four.
By Order of the Corporation,
IIs.
IIs.
IIs.



TWO SHILLING WATER-WORKS NOTE ISSUED BY THE CITY OF NEW YORK IN 1774.

"for a reservoir, provided that, upon sinking a well there, good water be found." The water, it seems, proved satisfactory, for on Aug. 25, 1774, treasury notes to the amount of £2,500, or about $12,000, were ordered issued. These notes were of five denominations, there being 4,000 each of sixpence, one, two and four shillings, and 2,500 of eight shillings value. The two-shilling notes are shown by the accompanying cuts, which are photographic reproductions of "an engraved fac-simile of one of these notes" which appeared in the "Memoir of the Croton Aqueduct," prepared by Charles King under official instructions and published by him in 1843.

One side of the note represents the machinery by which it is probable that Mr. Colles proposed to raise the water, a Newcomen atmospheric engine.

STREET PAVEMENTS IN BOSTON AND OTHER CITIES.

The following interesting matter relating to street pavements is condensed from the report of the Boston Street Department for 1891, as follows:

Jan. 31, 1892, Boston had a total of 434.59 miles of accepted streets, or 7,948,170 sq. yds. These streets have all been graded except 10.3 miles.

The length in miles and area in square yards of the different kinds of pavements is as follows:

Material:	Length.	Area.
Sheet asphalt	4.16	65,405
Block asphalt	.48	8,501
Block	69.29	1,521,562
Brick	0.36	3,658
Cobble	5.94	80,389
Telford and Macadam	304.56	3,735,106
Gravel	139.48	2,311,628
Not graded	10.30	201,941
Total	434.59	7,948,170

The following table gives a very interesting comparison of the character of the paving of seven large American cities, including Boston. The figures for the latter are for 1891 and all the others for 1890, so that the comparison is not quite fair, but the percentages might not be much varied if the figures for the other cities were for 1891.

Percentages to Total Lengths of the Various Kinds of Paved and Improved Streets in Seven American Cities.

	Washington.	St. Louis.	Chicago.	Buffalo.	New York.	Phila. delp'a.	Boston
Sheet asphalt	26.07	0.91	0.76	30.49	3.44	3.23	0.96
Coal tar	23.06						
Asphalt block	5.19	....	0.02	....	....	2.47	0.11
Block stone	14.18	29.07	3.45	40.45	67.61	15.09	15.94
Wood	0.18	1.25	61.27				
Cobble	6.94	....	....	....	00.79	49.21	1.37
Vitrified brick	....	....	....	0.02	....	2.60	00.06
Rubble	....	....	....	....	....	15.16	
Telford (a)	....	4.34		0.29	....	....	10.00
Macadam (a)	4.83	64.40	33.90	28.75	5 10	11.64	37.07
Gravel (a)	19.55	....	....	....	33.15	....	34.47
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Mileage	165.70	421.97	669.64	347.75	475.16	762.20	434.59

Commenting on the above table and upon street paving in general, the report, with slight condensation, states:

An inspection of the foregoing tables shows that in Boston only 15.9 per cent. of the total mileage is paved with granite blocks, 1.07 per cent. with asphalt, .08 per cent. with brick, 1.4 per cent. paved with cobble, the remainder, 81 per cent., being either macadamized or graveled.

The percentage of macadam and graveled streets is larger than most of the other cities in the country. St. Louis, which compares the nearest with Boston, having 64 per cent., while Buffalo has but 30 per cent. macadamized, and over 70 per cent. of its streets well paved. This large percentage of macadamized streets accounts largely for the expense of maintaining the department, compared with other cities.

The inferior condition of most of the paved streets of Boston is apparent to every one. Several causes have operated to bring this condition about.

In the first place, the quality of the stone blocks with which the pavement was originally laid was poor; these blocks, in most instances, were roughly cut, of irregular dimensions, and laid without proper care, so that, in some cases, even where the original pavement has never been disturbed, it has worn unequally and has settled in such a manner as to present a very uneven surface.

The numerous structures under the pavement, consisting of gas pipes, water pipes, telephone conduits, steam-heating pipes, electric wire conduits, and sewers with their connections, necessitate a constant tearing up of the pavements to make connections and remedy breaks and defects. There is also the tearing up and replacing of railroad tracks which is continually going on.

The continual disturbance of the pavement and the impossibility of replacing it over an excavation in such a manner as to leave the pavement in its original condition has resulted in the present uneven appearance of many of our streets, making them uncomfortable to travel over and difficult to clean.

It will be impossible to construct and maintain first-class pavements in our commercial and business thoroughfares as long as private corporations are allowed legislative franchises to not only cover the greater part of the surface with railroads, drip-boxes, manholes, gate-boxes, and covers of all sizes and kinds, but also to undermine the same with a perfect network of contrivances, some seething with steam, some flowing the most volatile, gas-producing and inflammable hydrocarbons, and some conducting the electrical current—all being liable to get out of repair and requiring excavations and disturbance of the street surface to keep them in condition.

The spirit of self-interest and desire to realize large dividends tends toward the greatest economy on the part of corporations in replacing the disturbed portions of street and pavement, thus leaving to the city a great deal of work to finally adjust and regulate at the expense of the public funds.

The only complete remedy for these evils is to build a large brick subway beneath the sidewalk or roadway capable of containing every wire or pipe needed for all purposes, with only its manholes appearing at the surface.

Until such time as an underground conduit of a size sufficient to contain all gas, water, and other pipes and wires is laid, it will be impossible to prevent the tearing up of the pavements, and dependence must be placed on the power of the department to grant or refuse permits and to have all openings repaved in as good a manner as possible under the circumstances. The amendment to the ordinance made this year, whereby the parties who make openings are obliged to keep the pavements in repair for six months, and, on their failure to do so, to be obliged to pay the cost

(a) Not usually separated in the reports of the various cities.

of the city's doing the work, will tend to lessen these evils.

During the year 11,320 permits to open streets were granted. The excavations under these permits aggregated 110.7 miles in length, or over 25 per cent. of the total length of streets.

On the subject of macadamized streets the report states that all such streets within the city proper, except those with a grade of more than 6 per 100, and all the main macadamized avenues leading to the suburbs, should be paved with granite blocks or asphalt as rapidly as the city's finances will permit.

Regarding the character of the paving put down in 1891 the report states:

The pavement laid this year has been laid in accordance with the best modern practice, and in accordance with what seemed for the best interests of the community.

The business streets in exclusively commercial sections subjected to the heaviest travel have been paved with granite blocks.

Where all water, gas, sewer, telephone, and other pipes are already laid, and where there is reasonable cause to believe that the pavement will not be constantly torn up, the blocks have been laid on a concrete base of hydraulic cement, and the joints filled with pebbles and road-pitch. A concrete base is especially applicable in loose soil where there is liable to be trouble from sub-soil water.

The streets subjected to heavy travel in which the various pipes have not as yet been laid have been paved with granite blocks on a gravel base in the ordinary manner; more attention, however, has been paid to rolling and preparing the foundation bed than was the practice in former years, with the result of securing a more even pavement.

The residence streets, where sufficient appropriation existed, have been paved with sheet asphalt, asphalt blocks, or brick, as seemed most suited to the case in hand.

Brick paving has only obtained on a few cross-streets, with a view to putting it to a thorough test. It can be used to advantage on streets of comparatively light traffic, where a less expensive form is desired than asphalt.

It is believed that the above kinds of pavement include all the varieties necessary to pave our streets in a first-class manner. Wood pavements, which are extensively used in Western cities and in cities abroad, are not adapted to this city. The difficulty of keeping them clean, owing to the tenacity with which filthy matter of all kinds adheres to them, and the exhalations which arise from their absorption of fluids, render them an unsanitary pavement. They are short-lived and require frequent repairs.

The granite-block pavement laid on a base of hydraulic cement concrete is believed to be the pavement best adapted to our business streets, especially where all water, gas, telephone, and electric pipes have been laid and connections made. This pavement possesses the advantage of the longest life, is easily cleaned, gives a good foothold for horses, and requires but little expenditure for repairs. Its chief disadvantage is its noise. The average cost of this pavement, including all labor and materials, is $4.70 per sq. yd.

The method of preparing the concrete foundation, its advantages and disadvantages, and the use of pitch and pebble joints for granite pavements are discussed in the report as follows:

The addition of a concrete base to the ordinary granite-block paving is no new experiment, but it has been employed to only a limited extent heretofore in Boston. Its advantages are marked, and its use for streets with the heaviest traffic is to be commended. It consists of a solid foundation layer or sheet of cement concrete, from 6 to 8 ins. in thickness, and covering the entire area to be paved; upon this the blocks are set in the usual manner, on a layer of sand about 2 ins. in thickness. The paving may then be finished in the usual manner, by filling the interstices between the blocks with coarse sand or fine screened gravel, or they may be filled with heated pebbles and melted pitch, as was done on Tremont St. The pitch-joints have no necessary connection with the concrete base, and either one is used without the other.

The advantages of the concrete base are those of a good foundation, which is indispensable for all good work. The concrete foundation is superior to gravel, however well compacted; and it serves the same good purpose in block paving that is does in asphalt paving.

As a preliminary to all paving, the various pipes and structures in the street must be put in order, and more or less trenches or other excavations made. The concrete base practically overcomes uneven settling, by bridging over the trenches and distributing the weight of travel over larger areas. Again, the paving-blocks are set in 2 ins. of sand on a concrete base, and on 6 ins. of gravel in ordinary paving. The settlement in the 2 ins., due to uneven depths of stone, is much less than in the paving on gravel, giving a smoother surface, and additional settling of each block independently of others is entirely prevented.

The disadvantages of the method are: 1. The extra cost. This will not exceed $1 per sq. yd. for ordinary street paving. 2. Difficulty of excavation for repairs, etc., of pipes in the street, and extra cost of replacing the pavement properly. It must be conceded by all that the primary and principal use of streets is for highways, and their use for pipes and structures is secondary and incidental. This is fully recognized in the authority over the streets given to the Superintendent, who controls their opening, under the proper legal limitations, for any purpose whatever; moreover, the difficulty of making excavations will obviously lead to the more careful construction of buried structures, and to the invention of methods of using them without removing the paving. As an instance, note that until within a very few years it was necessary to make an excavation in the street every time the city water was turned on or off a customer's premises.

3. The concrete foundation makes a water-tight layer, covering the street, and graded so as to turn all the water that penetrates the layer of paving blocks to the gutters. In streets having areas under the sidewalks, this is liable to make trouble from the water leaking through the wall and showing itself in the area. Care has been taken to make a water-tight joint in such cases.

The filling of the joints of the paving-stones with heated pebbles and pitch has been successful, and has done away with leaving a layer of gravel on the stones to be ground up by teams, and to become a nuisance to the public. The method of filling the joints promptly and effectually with pebbles and pitch avoids the long and dirty process of grinding up gravel by teams, and allows the street to be cleaned at once. Paving has been injured by the removal of gravel before the joints were filled, and also by water carts sprinkling the layer of gravel. The sprinkling seems to prevent the ground-up gravel from penetrating the joints by caking in the upper part of the joint. All gravel used for covering off paving, as it is termed, should be thoroughly dry when applied, either naturally or artificially.

Better work can be done in the hot, dry weather of summer than in the shorter and cooler days of the fall. This is especially true of all pitch-joint work. It cannot be properly done when the stones are wet, or so cold as to chill the pitch at once to so low a temperature that it loses its waxy consistency. It would probably be an improvement to use more fluid pitch than has been done before.

A large amount of asphalt pavement was laid during the year. All such pavements are kept in repair at the expense of the contractor for five years. The report states that if asphalt pavements are kept free from mud and sanded when sleet falls upon their surface they give a better footing than stone pavements. The report also states that statistics prove that more horses fall per mile on stone than on asphalt. The cost of asphalt pavement in Boston in 1891 averaged about $3.50 per sq. yd. This cost is said to be about 10 per cent. greater than that of a first-class granite block paving on gravel, and the cost of maintenance for a term of years is also greater; how much greater has not yet been determined. But where the expense can be borne, and in streets suited to its use, it is considered the best pavement that can be put down. From a sanitary point of view it leads in desirability, owing to its smoothness and consequent ease of cleaning and its absolute imperviousness to moisture.

Asphalt block pavement has been used on several streets, it having the advantage of being easily replaced after excavations in the street have been made.

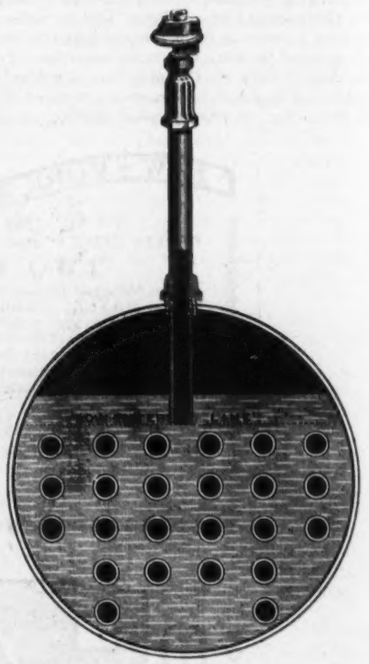
In 1888 Hamilton Place, a private way, was paved with brick, and is now in good condition. The travel here is so light that conclusions cannot be drawn regarding the use of brick. In 1891 three streets were paved with brick, making 0.36 mile now in use. Two of these streets were paved with a Keramite brick, at a cost of $2.75 per sq. yd., and the third street with a brick made in Rhode Island, at a cost of $2.40 per sq. yd.

In laying brick on the three streets last year the macadam was first excavated to a depth of 7 ins. and the roadbed rolled with a horse roller. The roadbed was then covered with 2 ins. of gravel, and rolled, and the bricks laid in a thin bed of sand and rammed to place. The brick were then flooded with water, rammed to a true surface, and the joints grouted with Portland cement mortar, mixed 1 to 1.

In 1892 it is proposed to lay some brick on a concrete base, and to make other experiments in this connection.

THE VAN AUKEN FUSIBLE LOW WATER ALARM.

The number of reported boiler explosions in the United States in 1891 is given as 284, with a loss of 317 lives. Some 80 per cent. of these explosions are known or supposed to have been caused by low water. Many forms of automatic alarm against this danger have been tried, and several of them have been successful. The one illustrated herewith is one of the newest, and is claimed to have some decided advantages. The alarm consists of a ½-in. pipe inserted through a ¾-in. hole tapped in the top of the boiler, the lower end of the pipe reaching to within 2 or 3 ins. of the top of the flues or crown sheet. When in use, under conditions of safety, this pipe remains full of water. At the top of the pipe is a fitting which holds a disk of fusible metal



Automatic Low Water Alarm for Boilers.

which is normally in contact with water. In case the water level drops below the lower end of the pipe, the steam is admitted and the disk melts immediately, allowing an escape of steam which gives an alarm. The construction of the fitting which holds the disk is such that when the disk is in position and the valve open it may be screwed down, and in this way is firmly locked beyond the possibility of opening until the disk is melted, and neither can the valve be again closed so long as the disk remains intact.

The details in which this device is claimed to be new are (1) that the fusible disk is not melted out by fire, as happens with some other devices for this purpose, but is melted out by the direct action of hot steam on the fusible alloy which melts at a temperature of 240° F. 2. The alarm is not prevented from working by any accumulation of scale or foreign substances in the boiler, nor can the disk become coated so as to increase the temperature at which it melts; which last causes great trouble with some forms of fusible plugs which have been used, for unless they are cleaned about as often as the boiler is washed out, the accumulating scale makes the melting of the plug unreliable or even prevents it altogether. 3. In case a disk melts in the Van Auken alarm, it is not necessary to shut down the work, as the valve can then be closed, preventing the further escape of steam, and a new disk in-

serted immediately. 4. The alarm is self-locking, and cannot be tampered with under any circumstances; besides which no keys (which are liable to be lost or stolen) are required. The alarm can be furnished with or without whistle attachment, and is manufactured by the Van Auken Steam Specialty Co., 201 to 207 South Canal St., Chicago, Ill. It would seem to have some very good points about it.

BENDING TESTS AND CONTRACTION OF AREA AS PROOFS OF QUALITY.

By. P. Kreuzpointner.*

It is a peculiarity of soft steel having under 70,000 lbs. per sq. in. tensile strength to show in the tensile test little or none of the effect of having been burned. The writer has burned soft steel to scintillation, so that it was rough and "lumpy" on the surface, and yet the metal would have filled ordinary specifications. This is still more apt to be the case if the metal is burned while being rolled and receives more or less work afterwards. The effects of burning are, of course, modified or aggravated by the chemical composition of the steel.

While overheated steel which stands the tensile test, may not be dangerously defective in certain positions, yet there is a risk attached to its use; and if that risk can be avoided it is better for the engineer and the steelmaker. Burned steel has its elasticity and density impaired. This is more or less restored by the slow stretching of the metal under tensile test, which is like so much additional work put on the metal; hence the apparently satisfactory results of such burned metal in tensile test.

The engineer finds a means to discover burned metal in the bending and nicking test, especially the latter. Prof. Krohn is, therefore, perfectly right when he says:

> Bending tests give us the surest method to discover burned metal. If the test piece is previously nicked it will show its brittleness by breaking readily after bending it to a comparatively small angle, and the fracture will reveal the characteristic coarse grained burned structure.

The nicked bending test is also very useful in determining the variations in quality of good structural metal. Aside from the question of injury by burning, there are degrees of excellence in metal of nominally the same grade. In a nicked bending test the best metal will bend to the greatest angle before breaking.

The wise engineer will sometimes have occasion to take advantage of this simple means of discrimination and will use the best parts of a shipment for the more important portions of his structure. Such nicked bending tests may be conveniently made in the vise, or by holding the piece tight between the anvil and the piston block of the steam hammer and striking it with a hammer or light sledge. After the first or second blow the metal will perceptibly stiffen as the next few blows are delivered. Afterward the resistance remains constant until the piece breaks. The metal which is not quite so good will break with a less angle of bend at the beginning of this stiffening period.

An expert can thus in an emergency determine the quality of a metal pretty closely. Even the elongation can be determined approximately by a bending test, without nicking the test piece. If the datum points or punch marks are laid out on the straight piece and it is then doubled, without hammering it flat, so as not to disturb the marks, the distance measured around the convex surface of the bent piece between the original marks will approximate, and sometimes equal, the amount the piece would have elongated in the tension machine.

It is not always necessary to nick a test piece before bending in order to discover its burned condition. On the convex surface of a bent piece of "soft" burned steel, there are visible numerous little cracks, very small and but skin deep, but sufficient to give the surface a rough appearance, which is not observed on a sound piece when bent double. But one unfamiliar with testing will find the nicked bending test a more satisfactory method of discovering burned metal. In using the latter, however, it must be remembered that soft steel will often show a granular fracture, especially if thicker than 3-8 in. The bending fracture of burned steel has a whitish hue; the crystals shine bright and fiery and show distinct, well-defined faces, whether large or small, and the granular or crystalline appearance of the fracture is very marked and coarse.

The nicked bending fracture of soft steel not burned will have a bluish gray hue, with the structure not sharply defined or even "mushy" in appearance, though otherwise "clean" and free from defects.

The fracture of a nicked bending test is really a safer index of the structure of a metal than the fractured surface of a tensile test piece. In the latter case all evidence of the original condition, that is, of the condition of the metal before it was subjected to stress, is changed or entirely obliterated through the strain exerted on the metal at the point of fracture, which is like so much additional work put on the metal by roll or hammer. The force necessary to pull the piece apart is generally sufficient to change the structure at the point of fracture from coarse to fine, or from fine to amorphous or silky.

A few words now on contraction of area at the point of fracture as an index of the quality of the metal. In order not to be misunderstood, the writer would emphasize the statement that to the expert in the physical laboratory contraction is a valuable indicator of the qualities of a metal, and in special cases when very soft steel or iron is under consideration it is even a practical guide to determine the suitableness of the material for a given purpose.

But with these qualifications ends the everyday practical usefulness of contraction. The fact is that contraction retains a certain amount of importance by virtue of other measures which accompany it. If left to stand on its own merits, it is a failure; and it proved a failure in the old German Government specification, where strength plus contraction was the prescribed standard measure of quality. Even Woehler, who was the father of the contraction theory, could not secure another official recognition for his pet child.

The crucial way to ascertain the value of a test for iron and steel is the ability to determine by it and with it alone and without the additional help of other tests, the main characteristics of a given metal for a given use, with fair accuracy.

In the elastic limit alone we have a pretty safe indication of what the metal will endure in service. The ultimate strength taken by itself is certainly useful to the designer. The elongation, being proportioned to the resilience, gives us an indication of that characteristic of a metal, but at the same time is a reliable measure of ductility in all parts of the metal under stress and as such is a trusty exponent of excessive softness or brittleness. The nicked bending test not only reveals defects in structure or homogeneity, but in case of emergency can be made to do duty for the more elaborate tensile test.

But what value has contraction of area by itself if we should happen to know nothing else of the metal? Whoever was able to establish the proportionality of contraction to strength or durability? No use can be made of it as an emergency test because before contraction can be measured the most important qualities of elastic and ultimate strength and ductility have already been determined. As an additional measure for ductility it is of no use to those who recognize elongation as a ductility measure. If elongation is a standard measure for ductility, what do we need another less reliable standard for? To check off a more reliable standard?

Again, is it rational, scientific, or in the interest of safety and economy to adopt a test as a standard which cannot be accurately made? Even ardent admirers of contraction admit that no two men can measure contraction alike, nor can the same man measure contraction alike twice in succession. Elongation presents no such difficulties, nor does it indicate local conditions only in the metal, which is a fault of contraction. If the metal is burned, elongation and other tests will show it before contraction. If the metal is highly heated only, contraction will probably be excessive and thus will show an exaggerated value of the metal which it does not possess. Hence, a double standard for measuring ductility is an absurdity which does mighty little good in specifications, but is liable to do a great deal of harm in more than one way.

The writer knows of cases where really first-class steel was rejected because of little contraction, and second-class metal was accepted. Thus the engineer cheated himself and forced the manufacturer to furnish a poorer grade of material against his will. Excessive contraction indicates excessive softness, and metal excessively soft is wanting in the elasticity and resilience which enables a metal to withstand shock and vibration.

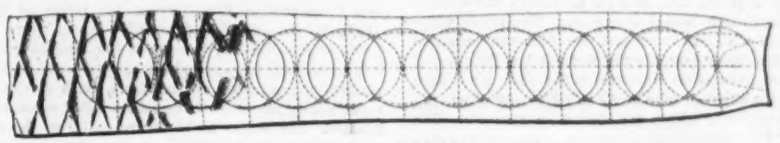


Fig. 1.

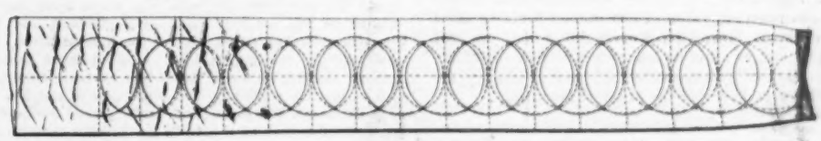


Fig. 2.

TENSILE TESTS OF STEEL.

The relation between the percentage of contraction and the limit of elasticity is something which no engineer ever attempted to express mathematically. Hence when a minimum percentage of contraction is specified there is no assurance that the metal, while very ductile, may not be objectionably low in elastic strength.

The deceptive nature of contraction as a test of the quality of metal is well shown by the two test pieces illustrated herewith in Fig. 1 and Fig. 2. Lines and circles were drawn on the flat surface of each test piece before and after test. The ellipses in the figure are the circles drawn before test, which were elongated to their present form by the stretching of the metal. The distance between the circles and the ellipses, therefore, shows the elongation and flow of the metal at different points of the test piece. The original width of each test piece is shown at the extreme left where the grip marks are.

Comparing the results shown by these pieces we find that the metal in Fig. 2 had 5,000 lbs. higher elastic limit and a proportionately greater ultimate strength. The elongation in Fig. 1 is greater by 6 per cent., and contraction is greater by 12 per cent., than in Fig. 2. Measured by Prof. Krohn's arbitrary standard of value, the metal in Fig. 2 would be rejected, having but 38 per cent. contraction instead of the prescribed 40 per cent.

This shows at once the absurdity of setting up contraction as a test for everyday use. The metal which possesses the desirable quality of high elasticity is to be rejected because it has 2 per cent. less contraction than is specified, a test whose results are so difficult of measurement that any one may miss it by 2 per cent. On the other hand, the metal of 5,000 lbs. lower elastic limit is to be accepted because of a greater percentage of contraction as

* A paper suggested by reading Prof. Krohn's investigation of soft steel (Eng. News, Jan. 9-16, 1892) and some of the comments thereon.

the point of fracture, which may be due to a soft spot in the metal indicating want of uniformity.

But referring again to Figs. 1 and 2, which are accurately reproduced from the original test pieces, it will be seen by the circles and ellipses that the metal in Fig. 2 stretched very regularly, and tapers down gradually to the point of fracture, where it contracts sufficiently to show a well-worked, sound metal. The metal in Fig. 1, however, stretches more at one place than another, and indicates to the expert, rapid flow, lack of "body" and liability to easy "fatigue," which means fracture in detail and short life.

At the conference held at Dresden, Munich, and Berlin to establish a standard code for testing, and with such eminent authorities as Bauchinger, Martens, Tetmajer, Goedicke, Hartig, Belelubsky, Brauns, Bach, Kerpely and Kik, it was decided that: "Only the work done by the test piece before the beginning of contraction is of any practical value." Kirsch, at the Royal Test Department in Berlin, came to the conclusion during his researches on the flow of metals that: "When a test piece breaks without contraction, whether with or without the forming of a 'cup,' and provided there are no such defects in the material as would naturally prevent or augment contraction, then the material possesses the highest degree of uniformity in regard to flow." This is another confirmation of the statement that the metal in Fig. 2 is superior to Fig. 1, though the stickler for contraction would reject it. Tetmajer, while agreeing with Kirkaldy and Woehler that contraction measures the ductility of the metal at the point of fracture, asks what practical value such a measure has to the engineer who needs to know only what the metal can stand within the maximum strength. He says: "Contraction and elongation at the point of rupture are of no practical value to the engineer." Hartig and Jenny agree with him. Many other authoritative statements as to the deceptive nature and lack of practical value of contraction could be cited to convince the progressive engineer that he will run no risk at all if he leaves contraction out of his specifications and reserves this part of inquiry for special occasions and the physical laboratory.

THE REVERE, MO., TRESTLE WASHOUT.

This severe accident, the worst of the week, as noted on another page, happened at 1:45 a. m. May 5, to the eastbound transcontinental express on the Atchison, Topeka & Santa Fe R. R. We have been favored by Chief Engineer Jas. Dun with the following abstract of the official report of the accident, made to Mr. A. A. Robinson, Second Vice-President:

Train No. 6, having from Kansas City regular No. 4 from the west, and the postal car, left Revere at 1:33 a. m. May 5. One mile east of Revere, when on trestle bridge No. 365, the trestle gave way, and all of the train except the engine and the rear sleeper fell into the opening. The water had risen about 10 ft. in the stream, and extended across the opening from base of one dump to base of the other. Drift had lodged against the middle bents and had moved them from 1 to 3 ft. out of line, the current in the creek being very strong.

As soon as the train went on to the bridge Engineer Crane felt it swing, and put on the emergency brake. The engine went across on to the fill and was derailed, but stood up on the ties. The postal car turned over to the right and off of the four east bents, which remained standing. The next six bents toward the west went down, letting the smoking car, chair car and tourist sleeper fall on the ground between the channel of the creek and the standing part of the east end of the bridge, which is about the length of a coach. The baggage car also fell in with them, and these four cars lie almost side by side. The casualties to the people on the train were in these cars .The first Pullman was left standing with its west end on the top of the cap of the first bent at east end of the standing west part of the trestle, and spans the creek with its east end resting on the bodies of the cars that were ahead of it. The rear Pullman sleeper was left standing on the west end of the trestle, but slightly injured. There were 7 people killed and 32 more or less injured.

Reports indicate that a heavy storm, amounting to the nature of a cloud burst, passed over this territory about midnight, and again about 4 a. m., and the damage to the bridge was caused by the sudden rise of water due to the midnight storm. It had been raining hard nearly all the day before (Wednesday) starting about 8 a. m.

On the night of May 4 there was one section man walking track on west end, and one on the east end of this section; also one man stationed at slide one-half mile west of Revere. Section men went over section east of Revere and passed over bridge at 3 p. m. Nothing was wrong with it at that time.

In addition to the preceding Mr. Dun favors us with the following notes in regard to the structure itself:

Bridge No. 365, where the accident occurred, is a pile and frame trestle, 272 ft. long and 36 ft. high, across a ravine 0.9 mile east of Revere, Clark Co., Mo. The ravine is a branch of Dumas Creek, and heads about 2½ miles northwest of the bridge. The structure consists of 17 openings of 16 ft. each, resting on 18 bents, including the bank bents. All of the bents except two rested on pile foundation. The construction record shows that the piles penetrated from 8 to 12 ft. in the ground. At two points, however, piles could not be driven, owing to hard foundation near surface, and at these points pits were excavated to hard bottom and sill bents used. The dimensions of timber used in trestle are:

Guard rail	6x8
Cross ties	6x8, 9 ft. long, 16 ins. c. to c.
Stringers, six pieces	7x16
Caps, posts, batter posts and sills	12x12
Girts, 6x8, sway bracing	8x10

All material pine, except ties, guard rail, sway bracing and piles, which were of white oak. The bridge was built in November, 1887.

Mr. E. R. Shnable, Chief Engineer of the Western Construction Co., having his office at Fort Madison, Ia., only a few miles away from the scene of the disaster, but across the Mississippi and in another state, was kind enough to make an independent examination of the facts, with a view to ascertaining for us such as might be of engineering interest. He writes us in regard to it, on the very day of the disaster:

The accident on the A. T. & S. F. R. R. east of Revere is of no interest from an engineering point of view. The structure that gave way under train No. 6 (known as the vestibule) was an 8 pile-bent and 10 frame-bent bridge, 36 ft. high at the highest point. It was built by contract in 1887. A cloud burst forced a large amount of water down this ravine; the drift choked up the waterway and bents No. 8 and No. 9 were displaced. The engine and tender passed over safely, while the rest of the train went down, excepting the rear sleeper. Seven were killed and 31 more or less injured; 10 are now in the hospital, the rest are now proceeding on their journey.

The feature of this occurrence on which most stress should be laid, it seems to us, is that it is never safe to run over a trestle badly out of line, and the engineer of the train should have known this. We think it would be an eminently wise precaution for any road having a considerable amount of wooden trestle on its line to issue a general order to their enginemen, pointing out that this accident resulted from running onto a trestle in spite of this sign of weakness, and instructing them never to attempt to pass over such a trestle, especially after a severe rainstorm, without stopping to walk over it and carefully examine its condition. We can conceive of no circumstances under which it is defensible to do otherwise, or even to cross such a trestle at all with a train, until the water has fallen low enough to permit the foundations to be thoroughly examined. In almost every case any serious disturbance of line means that a trestle is unsafe for trains.

The accident also shows the extreme care which should be used in securing foundations for trestles over alluvial gullies, liable at times to carry a great deal of water. It is but just to add, however, that despite the hundreds of miles of wooden trestles in use in this country, there has not been another case of a serious disaster from a trestle washout in over two years. The following disasters in some way connected with trestles have been recorded in our "Worst Accident of the Week Notes" in 1890, 1891 and 1892:

1890.	k.	inj.
Feb. 1, L. N. A. & C. Derailment just before reaching trestle	5	17
Nov. 12, (Salem, Ore.) Failure of trestle from apparent weakness	4	50
Dec. 27, W. & L. E. Derailment just before reaching trestle	4	7
1891.		
June 6, N. & W. Rear collision on an old trestle being replaced by iron	1	1
June 20, C. M. & St. P. Malicious derailment on trestle 40 ft. high	3	50
July 11, K. & M. Trestle ties on fire	14	30-40
1892. None previous to May 5.		

THE COVERED WATER-WORKS RESERVOIR AT FRANKLIN, N. H.

The town of Franklin, N. H., built water-works in 1891, including a pumping station and covered masonry reservoir.

The supply is entirely from springs, seven of which are located on about one acre of ground. Each of these springs is inclosed by brick walls and an iron cover. An eighth spring is located at another point and is inclosed by brick walls. The seven springs have an average elevation of 24 ft. and the eighth spring is about 30 ft. above the floor of the pumping station. The difference in the elevation of the water level of the seven springs is 16 ft. Water passes from the seven springs to the pumping station through a 4-in. cement lined pipe part of the way and a 6-in. cast iron pipe the remainder of the distance. A 4-in. wrought iron pipe leads from the single spring to the pumping station. The 4-in. cement pipe was in use when the springs were bought by the town.

The water is pumped by a 500,000-gallon Deane water power pump through about 2,600 ft. of 10 and 2,000 ft. of 12-in. pipe to the reservoir, which is about 250 ft. above the pump.

The reservoir is shown by the accompanying drawings. Fig. 1 is a plan or horizontal section at the spring line of the arches. Fig. 2 is a vertical section through the structure and Fig. 3 a sectional elevation showing the outer ring of piers and the supporting arches of the roof. These sections show the structure and its various dimensions in detail, including the arrangement of the combined force and supply main and the waste and overflow pipes and other accessories.

The reservoir is so admirably described in the report of the engineer, Mr. F. L. Fuller, Boston, Mass., included in Franklin Water Commissioner's report for 1891, that we give the greater part of the description below, with a few slight abbreviations. Such detailed descriptions are sought by water-works officials and engineers and it would be well if more of them were written. The description, with a few remarks on the use of covered reservoirs, is as follows:

A circular excavation of an average depth of 13.7 ft. and diameter of 81.8 ft. was first made. A circular trench in which to start the masonry wall was made to a depth 2 ft. greater. Within the excavation was built a rubble masonry wall 21 ft. high. The thickness for the lower 2 ft. was 5 ft. From a level 2 ft. above the bottom of the wall, or at the level of the bottom of the reservoir, the wall decreased to a thickness of 2½ ft. at the top, the batter on the inside being 1 ft. and on the outside, 1½ ft. in 19 ft. The inside diameter at the bottom is 69, and at the top 71, ft.

This wall was built mostly of split boulder stone, laid in mortar composed of Rosendale cement and sand, in the proportion of one of the former to two of the latter. Nearly all of the stone was obtained on the land adjoining the reservoir.

After the completion of the masonry wall, two circular rows of brick piers, 1 ft. square, laid in Portland cement, were built. The inner row has ten piers 7.54 ft. apart on centers, the center of each pier being 12 ft. from the center of the reservoir. The outer row contains 20 piers of the same size and the same distance apart, but having their centers 24 ft. from the center of the reservoir.

The piers in each row are connected by lintel arches having a span of 6.54 ft. and a rise of 2 ft. These arches are 1 ft. thick. Those supported by the inner row of piers are on a circle 24 ft. in diameter, those supported by the outer row are on a circle of 48 ft. in diameter. These arches were laid on properly formed centers. Those required for the outer were somewhat different from those used for the inner row. The spandrel filling is of brick and carried up to the level of the crown of the lintel arch.

These two brick rings, carried by the brick piers, support the two brick covering arches and dome. The covering arches have a span of 11 ft., a rise of 1.5 ft., and a thickness of 8 ins. The dome covering the central portion, has a span of 23 ft. and a rise of 3.25 ft. Its thickness is also 8 ins. Before the covering arches were started, the embankment was raised to the level of the top of the masonry wall, to assist it in withstanding the thrust of the arches. This bank was thoroughly puddled and rolled, making it very compact and solid.

The covering arches and dome were built on accurately formed centers, supported from the bottom of the reservoir. These centers were allowed to remain as long as possible before removal, but as a considerable number of masons were employed, and as, in the case

of the covering arches, the same centers were used over and over again, they were generally removed on the third day, sometimes perhaps on the second. By having a larger number of centers they might have remained longer, but this would have caused the contractor considerable extra expense. Careful watch was kept of the brick work on the removal of the centers, but no settlement or change of form was observed.

A piece of 6-in. iron pipe extends through the brick work at the top of the dome, to which is connected a spherical iron casting, 10 ins. in diameter, pierced with ½-in. holes, which serves as a ventilator.

All brick work, except the piers, were built with Rosendale cement. In order to render the masonry wall as water-tight as possible a plaster coat, ½ in. thick, composed of equal parts of Portland cement and good sand, was applied to the inside of this wall and well troweled and worked into the joints. The bottom is covered with a layer of concrete 5 ins. thick. Over this was spread Portland cement mortar 1 in. in thickness, sloping toward the center. It had been the intention to use American cement for this finishing coat, but considerable spring water being encountered it was thought best to use the Portland cement.

kept for this purpose. The depth of filling over the top of the dome is about 2 ft. From the center there is a uniform slope in all directions of about 3 ft. in 44. At a distance of 44 ft. from the center the bank inclines downward at a slope of two horizontal to one vertical till it reaches the old ground. The side and top slopes were carefully graded and sown with grass seed.

The 12-in. main enters the reservoir with a uniform ascending grade so that there can be no air pockets and the reservoir can be drained to the top of the inlet pipe by opening blow-offs or hydrants at any lower level. This 12-in. main, which is both the inlet and outlet according to circumstances, enters below the bottom of the reservoir and terminates in a quarter bend at the exact center. The top of this quarter bend is six inches above the bottom of the reservoir at the center but at the same level as the bottom at the sides. In other words there is a uniform slope of 6 ins. from the sides to the center.

This lower 6 ins. can be drained out through a 6-in. waste pipe by opening a gate on the end of this pipe. The whole reservoir could be thus drained, but as this waste pipe opens into the gutter on the east side of Pleasant St. there would be danger of damage to water line of the reservoir and is 17.71 ft. above the bottom at the sides or above the top of the 12-in. outlet.

The capacity of the reservoir is 504,300 gallons. As the cost was $9,092.03 the cost per thousand gallons capacity is about $18.00. This is the second covered reservoir that has been built in New England and the first circular one (a). It will no doubt prove entirely satisfactory as the cost for repairs will be almost nothing and the water will be preserved from any contamination caused by any foreign substance getting into it. Access to the reservoir is had through a brick manhole having a heavy iron cover secured by a padlock. An iron ladder leads to the bottom.

Within the reservoir are two gates, a 6-in. one on the end of the waste pipe previously mentioned, and a 12-in. one on the 12-in. main. This is situated directly under the manhole. To the stem is fitted an iron rod extending slightly above high water line to which an ordinary gate wrench can be attached and the gate operated from the surface of the ground.

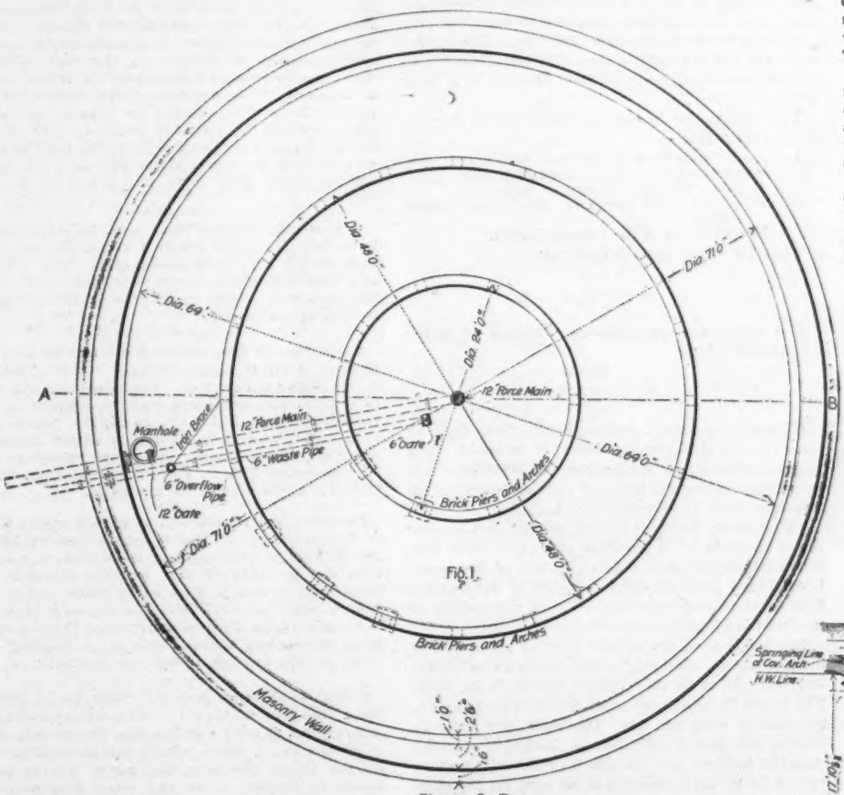
At the point where the 6 and 12-in. pipe enter the reservoir the masonry was carried about 2 ft. under the pipes and very carefully built around them. As an additional precaution a cast iron sleeve having a flange 6 ins. wide was caiked on each pipe near the center of the masonry wall, thus forming a cut-off to prevent the water following along the pipes and causing leakage. To all appearances the reservoir is perfectly tight.

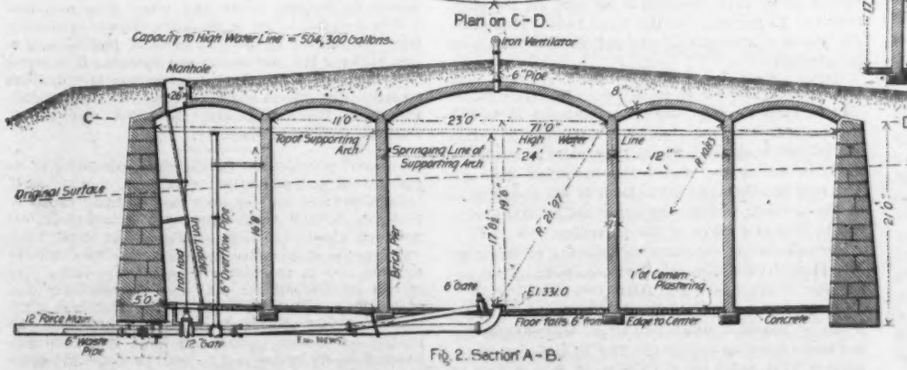
Covered reservoirs are now considered indispensable for the storage of ground or spring waters because an absence of light and heat prevents the minute vegetable growths which in many cases not only injure the appearance of the water but impart an unpleasant taste and odor.

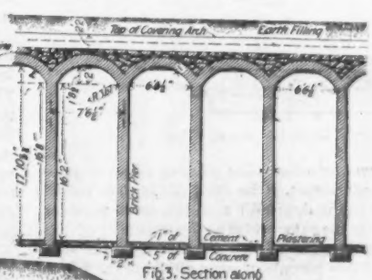
This reservoir has the advantage of being entirely enclosed except the comparatively small openings in the ventilator. The water is kept cooler in summer and warmer in winter, both of which conditions are desirable. Dust, leaves and vermin of every kind are absolutely excluded.

Near the manhole a piece of wrought iron pipe was laid through the brick covering arch to admit the proper wires for an electrical recording indicator in case one should be used. Such an apparatus will be found very convenient as by means of a dial and index located in the pumping station the exact height of the water in the reservoir is shown and the trouble and waste resulting from overflowing the reservoir will be avoided. A continuous record of the height of the water in the reservoir would also be kept and could be referred to at any time.

The contractor for the work was Mr. John H. Fuller, of Lowell, Mass. Mr. Fuller died shortly after beginning construction, but the job was completed under the contract with Mr. Joseph Bean,







COVERED RESERVOIR FOR THE WATER-WORKS OF FRANKLIN, N. H.; F. L. Fuller, Engineer.

The nature of the material in which the excavation for the reservoir was made is a clayey hardpan and so compact as to be picked with difficulty. It, however, formed an excellent bank when replaced around and over the wall and covering arches. Over this hardpan was placed about 9 ins. of the loam which had been removed from the surface of the reservoir site and the street by washing. In case of emptying the reservoir to clean it, it would be best to draw off most of the water through the mains by opening a blow-off or hydrant where the water could be taken care of.

A vertical 6-in. pipe extends upward from the waste pipe, below the 6-in. gate spoken of, and forms an overflow pipe. The top of this pipe forms the high

the contractor's foreman, in charge. As already

(a) The other covered reservoir referred to was built at Newton, Mass., in 1891. A covered reservoir at Hudson, Wis., was described and illustrated in Engineering News for March 15, 1890. Of course it will be understood that "reservoir" as here used is to distinguish between earth or masonry structures and metal or wooden tanks or stand-pipes.—Ed.

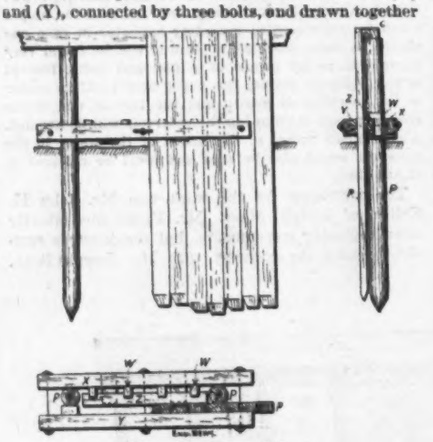
stated, Mr. F. L. Fuller, of Boston, Mass., was engineer for the work, and to him we are indebted for the illustrations presented, as well as the matter, for which credit has already been given.

The detailed cost of the work, as given by Mr. Fuller, is as follows:

2,882	cu. yds.	earth excavation.....at	$0.40	$1,153
715	"	rubble masonry..... "	6.80	4,861
19	"	Portland cem. brick work "	16.96	315
221	"	American " " " "	13.96	1,086
58	"	" " concrete... "	6.75	388
411	sq. yds.	finishing coat on bottom.. "	0.45	185
464	"	Portland cement plaster coat on sides..... "	0.40	186
53	lin. ft.	12-in. pipe laying..... "	0.50	26
74	" "	6-in. " " ..... "	0.35	26
Extra on account of using Portland cement on bottom, 40 bbls..... "			1.80	72
Portland cement, 2 bbls. used around pipes and gates..... "			3.40	7
Extra, not included above.....				127
			(a)	$9,632

CLAMP FOR SHEET PILING.

Every engineer who has had much to do with sheet piling has experienced the difficulty of holding it in line while being driven, and we give herewith a cut of a clamp designed by Mr. A. F. Walker, of Camden, S. C., for holding the piling to a true line. Mr. Walker states that he has had occasion to do considerable of this work recently, and not wishing to go to the expense of using squared guide piles and bolting three or four guide wales to the same, the work was very unsatisfactory until he devised this plan, and since then the work has progressed very favorably. He first drove round guide piles 7 ft. apart (P), cut them off level, and drift bolted caps to the top, letting the face of the caps project a very little beyond the face of the round pile. This forms a permanent support to the top of sheet piles (p). Near the ground line he placed in position the clamp shown on the plan. This consists of two sticks (X) and (Y), connected by three bolts, and drawn together



Clamp for Sheet Piling.

as tightly as the intervening piles or pile and gage block (G) will permit. The stick (Z) is then forced forward by the wedges (W) until the space between (X) and (Y) is the same width as the thickness of the piles. The pieces (X) (Y) (Z) are slotted for the middle bolt, and this permits of some adjustment. When one of the piles partially closes this slot, a notch is cut in the same large enough to receive bolt, and the bolt slipped up to it and tightened. This allows of the next pile being driven as close as the others. When one panel has been completed the nuts are removed and the clamps moved forward to the next one, a notch being cut in the end pile to receive the end bolt of the clamp. The piles are sharpened flatwise with a little more slope on the side facing the guide piles. This gives them a tendency to drive away from the guide pile at the foot, and to bear, in consequence, against the cap (C) at the top. A slight bevel is also given to the edge, to make the foot crowd against the adjoining pile. During the first half of the driving the joint is held a little open at the top, but during the latter half pressure is brought to crowd it toward its neighbor, and the joint will close as tightly as possible.

WATER MAINS OF WOODEN STAVES.

In our issues of April 28, 1888, and June 13, 1891, the methods of constructing the wooden water mains of large diameter, which have been so successfully used in Colorado and other parts of the West, were fully described and illustrated. At a recent meeting of the Technical Society of the Pacific Coast Mr. D. C. Henny read a paper on this subject in which some further facts and figures are given. The cast iron shoe for the bands on the pipe which we illustrated on page 558 of our issue of June 13, 1891, does not have the pull on opposite ends of the band in the same line, and hence there is a twisting strain upon the shoe. In the shoe described by Mr. Henny this fault is obviated.

Concerning the necessary thickness of the staves, Mr. Henny said that he had seen redwood staves 1⅜ ins. thick which showed no signs of leakage under a head of 165 ft. A certain thickness is, of course, necessary to enable the pipe to keep its circular form. The first wooden main built in Denver was 48 ins. in diameter and was built of 1⅝-in. staves. In good ground this pipe preserved its circular form, but part of the line laid in soft muck became elliptical in section, having the long axis at some points horizontal, at others vertical. The pipe was brought back to a circular form by dumping slag from the smelters alongside or over the pipe according to the shape of its distortion. The largest redwood pipe yet built is one of 72 ins. diameter on the Maxwell land grant in New Mexico. It is built of 2½-in. staves.

For spacing the bands Mr. Henny gives the following formulas:

Let L=distance between adjacent bands, c. to c.
S=admissible strain on band in pounds.
J=inside diameter of pipe in inches.
P=pressure of water in pounds per square inch.
H=thickness of the stave in inches.

Then for safety against bursting:

$$L = \frac{2\,S}{d\,P}$$

For safety against excessive deflection of staves at the butt joints:

$$L < \frac{25.6\,H}{\sqrt[3]{P}}$$

He states, however, that the second formula is of somewhat doubtful value, since it is based on a modulus of elasticity for bending of 1,600,000, which is perhaps somewhat high for redwood, also on an arbitrary limit of deflection of $\frac{1}{1000}$.

The greater bearing surface of flat bands over round bands is of no practical advantage since it is found in practice that the indentation of the round bands is not great enough to perceptibly damage the fiber of the wood even when 60° of the section of the band is in contact with the wood.

The bands used are of mild steel of about 60,000 lbs. per sq. in. strength, which increases to 65,000 lbs. in ½-in. rods and 70,000 lbs. in ⅜-in. rods. The larger diameters are upset for the screw thread; the smaller sizes are not. The metal cut away in cutting the thread, Mr. Henny thinks, is stronger than the body of the rod, and he reduces the above values for ultimate strength 5 per cent. on the large rods and 10 per cent. on the small rods. This gives for ultimate strength of the rod at the bottom of the thread:

Diam. of rod, ins.	⅜	½	⅝ or over
Ult. strength, lbs. per sq. in.	63,000	58,500	57,500

In building the pipe, one gang can build 75 to 175 ft. per day. On long pipe lines a number of gangs are put at work, and where they meet a buckle is made by fitting the staves and springing them in. The pipe can be made to conform to the undulations of the ground, within reasonable limits; 30-in. pipe can be laid to a curve of 250 ft. radius.

For calculating the carrying capacity of this pipe Mr. Henny used Kutter's formula, putting the coefficient of roughness n at 0.010.

Comparing the cost of this pipe with that of sheet iron pipe, the wood pipe is 5 to 10 per cent. cheaper for the same carrying capacity. The 16 miles of 30-in. wooden pipe built by the Citizens' Water Co. of Denver cost about $160,000. The estimated cost of riveted iron pipe for the same work was $333,000, and of cast iron pipe $717,000. The above pipe is under a head of 40 to 220 ft. It was built of Texas pine. If California redwood had been used (as it will be for all new pipe lines now contemplated by this company), the cost of the wooden pipe would have been about $185,000.

Besides a number of short irrigation siphons in Colorado and New Mexico, Mr. Henny stated that 58½ miles of wood pipe have been built during the past eight years, varying from 12 ins. to 48 ins. in diameter. The bulk of this is laid in the vicinity of Denver.

The list prices of the Excelsior Redwood Co. are as follows:

Diam., ins.	12	16	20	24	30	36	42	48
Cost per ft:	$.80	$1	$1.30	$1.50	$1.75	$2.05	$2.35	$2.65
Diam., ins.:	54	60	72	84	96	108	120	
Cost per ft.:	$4.35	$4.80	$5.00	$7.25	$9.60	$10.80	$13.10	

These figures are for pipe banded every 12 ins. and include cost of erection.

The city of Worcester, Mass., proposes to add ten tanks to its sewage precipitation works, making 16 in all and increasing the daily capacity of the plant from 4,000,000 to about 10,000,000 gallons per day, or more. The plant gives good satisfaction, but can handle only a part of the total sewage of the city. For a full illustrated description of these works, see Engineering News of Nov. 15 and 22, 1890.

A bill providing for the purchase by the city of Brooklyn of the property of the Long Island Water Supply Co., has been signed by Gov. Flower. The bill provides that the property be appraised by a Commission appointed, we believe, by the Supreme Court. The company supplies water to the Twenty-sixth ward of Brooklyn, the former town of New Lots, which was annexed to the city just after the company secured the right to supply the town. In December, 1890, the city was on the point of buying these works, but was finally prevented on the ground of being about to pay an exorbitant price. (Eng. News, Jan. 3 and 10, March 7, 1891.)

A steel ship building plant is to be established at Bath, Me., by Arthur Sewall & Co., a firm which has built some of the largest wooden ships afloat. The keel of a large sailing ship is soon to be laid in their yards. The firm will confine themselves at present to the building of sailing ships.

A water supply from tunnels driven into the hills near Oakland, Cal., is being developed by the Piedmont Spring Water & Power Co. The supply is being piped to Oakland and distributed there in competition with the Contra Costa Water Co. In all, ten tunnels have been driven, and, it is reported, 2,000,000 gallons of water per day developed. One of the tunnels is 1,400 ft. and another 1,200 ft. above tide water. Mr. W. W. Dingee is at the head of the enterprise.

The River and Harbor bill, as passed by the House of Representatives on May 9, appropriates $21,346,975 for carrying on works already undertaken, and authorizes the Secretary of War to make contracts and begin work on certain other works whose total cost is now estimated at $26,702,321. In our issue of March 26 we enumerated the most important of the new works to be undertaken, among which is the securing of a 21-ft. channel between Duluth and Buffalo.

A large water-power project is under way at Helena, Mont. The Missouri River Power Co. has been organized and proposes to build a dam across the Missouri River at Stubb's Ferry, which will furnish about 15,000 HP. By the aid of electricity this power will be transmitted to Helena, Butte and other principal cities within a radius of 50 or 60 miles. Power in the district, on account of the high price of fuel, is said to cost $120 per HP. per annum and upward. It is stated that the capital for the enterprise has already been secured. The officers of the company are A. M. Holter, President; Barnard Brown, Secretary, and W. L. Darling, Consulting Engineer.

A heavy experimental freight train, consisting of 40 cars loaded with 66,000 lbs., or 33 tons, of grain each, being 6,000 lbs. per car over their nominal capacity, was run through from Chicago to Philadelphia last week on about the usual schedule, four days' time, with speeds of 15 miles per hour. The idea was to test the cars in use with a view to constructing cars of still greater capacity, and also the necessary cost of handling grain. The total paying load was 1,320 tons, dead load of cars about 520 tons, of engine and tender, say 80 tons, making 1,920 tons. The train was handled chiefly by one engine, with an assistant engine over the heavy grade sections. According to average American experience one engine can handle a train like this on a 0.2 per cent. grade, and two engines on a 0.8 per cent. grade (42 ft. per mile).

The time of the transcontinental journey has been again reduced by a new fast train between Ogden and Denver, which makes the run of 712 miles in 27 hours 20 minutes. The train runs via the Rio Grande Western, the Denver & Rio Grande, the Colorado Midland and the Rock Island, to Denver. From Denver to Chi-

cago a train over the Chicago, Burlington & Quincy makes the run in 28 h. 15 min., and from Chicago to New York by either the Pennsylvania or the Vanderbilt lines, the time is about 24 h. 45 min. Adding the schedule time between Ogden and San Francisco, 34 h. 30 min., by the train leaving San Francisco at 8 a. m., we have 114 h. 50 min., or 5 h. 10 min. less than 5 days, as the actual running time across the continent.

Platinum ore is reported discovered in the Black Hills, at a point about 25 miles west of Rapid City. The great use of the metal for electrical and chemical work make the discovery of new sources of supply a matter of much importance.

Shell paving is being laid at the town of Aransas Harbor, Tex. The material is shell and clay from the shore of the bay, which, when properly mixed, is said to form a good material, nearly approaching a concrete, and costing about 70 cts. per sq. yd., including the wooden curbing. For light traffic this is found very satisfactory. The work is in charge of Mr. J. H. Drummond.

A report on the project for improving Grand River, in Michigan, and making it navigable, has been sent to Congress by Colonel Ludlow, U. S. Engineer Corps, who recommends the dredging of the river so as to give an open channel of a minimum depth of 10 ft., and he estimates the entire cost of this improvement at $670,500. This estimate, however, includes a provision of $169,000 for wing-dams, which it is possible, Col. Ludlow says, may not be required.

The Commissioners appointed by the Court to review the work of the New York Rapid Transit Commission are taking testimony with reference to the feasibility of the proposed systems of lines. Mr. Charles Sooysmith testified that the tunnel under Broadway could be built without endangering buildings or seriously impeding travel. The cost of the construction in rock from Fourteenth St. to Thirty-Third St. he estimated at $3,500,000 per mile. Above Thirty-third St. the cost would be about $1,500,000 per mile. Experts of the Thomson-Houston Co. testified as to the practicability of electric locomotives, and stated that electric locomotives had been built with a tractive power of 15,000 lbs.

Work on the temporary Harlem River bridge, which will be used by the New York Central while the permanent bridge, recently authorized, is under construction, is expected to begin in about two months. The temporary bridge will be a pile structure, located 200 ft. west of the present bridge. The permanent bridge, with its approaches, is expected to require two years for its construction.

The Health Department of Milwaukee has had a disinfecting service in operation over three months. Its principal feature is a large disinfecting chamber mounted on wheels and resembling a furniture mover's van. This chamber is lined with iron, and between the lining and the wooden covering of the chamber is a non-conducting material. A small steam launch boiler, using oil fuel, is placed in one corner of the van, and steam radiating pipes are extended from it over the walls and floor of the chamber. The radiating surface is sufficient to heat the interior of the chamber to a temperature of 250° F.

When a case of contagious disease occurs, the disinfecting van is driven to the house, and carpets, clothing, furniture or any other portable articles, which may have been infected, are placed in the chamber and kept hot sufficiently long to insure the killing of all germs. At the same time the interior of the infected rooms is fumigated, and other sanitary precautions are taken. The apparatus is inexpensive, and seems to accomplish its purpose much better than the ordinary disinfecting station, to which articles are carried for treatment.

Aluminum is being tried for cavalry and infantry equipments, such as canteens, buckles and cooking utensils, following the precedent already set by Germany, in the U. S. Army. The official report states that the articles do not tarnish, and weigh considerably less than the present standard equipments.

The ventilation of the St. Clair tunnel is reported to be so poor that the company is having difficulty in inducing brakemen to operate trains through it. The tunnel is 6,000 ft. in length. The portion beneath the river is on a grade of 1 per cent. The approaches in tunnel are each about 2,000 ft. long and are on a 2 per cent. grade. Decapod tank engines with large boiler capacity are used to haul through the tunnel, and though they burn smokeless fuel, they discharge of necessity a great quantity of gas. The ventilation of the tunnels is provided for by two Root blowers at each end. A 2-ft. air pipe extends from the blowers to a point near the center of the tunnel. The capacity of each of these blowers is about 10,000 cu. ft. or air per minute, and the whole volume of air in the tunnel can be passed through the blowers in about 45 minutes. Press reports state that "experiments are being made with a gas consumer attached to the locomotive," but it is a difficult to see any chance for success in this direction.

The subject of street car fenders has again been investigated by a commission appointed by the West End Ry. Co., of Boston. One hundred and twenty-nine different fenders were submitted to the committee for examination, and they were classed as follows:

Buffers, which soften the blow given to the person by the car, and pick him up in a net; platforms projecting beyond the dashboards, upon which a person could leap, or upon which a body could be caught and carried along; fenders below the car platform, whose object it is to push along a body lying on the tracks, and prevent its getting under the wheels. Three methods of operation were also disclosed; Where they are always in place ready to catch a body; where they require the action of springs or other device, operated by the force of the blow struck by the car upon the body; where they require the direct action of the motormen to put them in operation.

After careful examination of all these the commission believe that public safety can be increased by the adoption of possibly two devices, as follows: A movable platform projecting in front of the car platform, with an elastic buffer of stout wire or metal strips, and curved so as to project from the front dashboard and receive the blow of a person's head and shoulders on a yielding surface. This buffer could be easily detached and changed from one end of the car to the other. The meshes of the buffer should be large enough to enable a person to seize it with his hands. The second device is to prevent a person who has fallen, and is lying on the track, from being run over by the wheels. The commission are not yet prepared to make any specific recommendations as to this latter device, but require more time for investigation and experiment.

In the committee's investigation it has visited the public buildings of various cities, and the report contains the following statistics of the City Halls in each:

City Hall:

City.	Material	Size; ft.	Floor area sq. ft.	Cost Total.	Cost per cu. ft., cts.
Detroit	Fr'stone	....	212,170	$600,000	18
				7	29 &
Chicago	.....	....	....	4,500,000	58(a)
St. Louis	Granite	....	....	2,000,000	38
Cincin'ti	S'dstone	332x284	187,792	1,500,000	42
Richmond	Granite	180x140	....	1,500,000	
Baltimore	Marble	238x149	184,839	2,271,135	66
Philad'hia	.....	470x486	1,147,672	16,000,000	58
Buffalo	Granite	276x160	190,932	....	51

Commenting on the Philadelphia City Hall, the committee say: "It is somewhat difficult to decide to what order or style of architecture this magnificent building may be credited." The Boston Aldermen are not the only persons who have met this difficulty.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

SANDUSKY & COLUMBUS SHORT LINE.—About 300 men and 150 teams are now at work on this line from Sandusky to Columbus, O. From Sandusky to Bellevue, O., 12.75 miles, were completed last year, and about one mile of switch track has been laid near Sandusky. It is expected to commence tracklaying on the extension from Bellevue to Columbus, O., by June 1, and to have the line in operation by Oct. 1. Ch. Engr., F. J. Aid, 91 Clinton Building, Columbus, O.

MONTREAL & OTTAWA.—It is stated that work will soon begin on a 22-mile extension of this railway from Rigaud to Caledonia Springs, Ont. Alphonse Charlebois, of Ottawa, Ont., is the contractor.

NEWPORT & SHERMAN'S VALLEY.—Surveys are now in progress for an extension of this railway from Blain, Pa., to Doylesburg, to Dry Run, Franklin Co., Pa.

BALTIMORE & OHIO.—It is stated that this company will build a short branch from its main line near Mt. Airy, Md.

PENNSYLVANIA.—Work is reported begun on the extension of the Turtle Creek Valley Branch from Murraysville to Belmont, Pa.

EAGLE'S MERE.—The forces at work on this short Pennsylvania railway will be greatly increased so as to complete the line by June 15.

READING, LANCASTER & BALTIMORE.—Work is being rapidly pushed by contractor E. H. Warren on the 10 miles from Reading to Adamstown, Pa. It is intended to complete this section before doing any further work. Ch. Engr., S. C. Slaymaker, Lancaster, Pa.

LANCASTER, OXFORD & SOUTHERN.—Thos. H. Connell, of Wilmington, Del., has the contract for building the 4.5 miles of this line to the Providence Paper Mills, noted in our issue of April 28. The contract price for completing the roadbed ready for the track is $68,000.

TOBIQUE VALLEY.—It is stated that work will soon be resumed on the extension of this railway to Plaster Rock, N. S. Ch. Engr., C. L. B. Miles, Upper Andover, N. S.

Projects and Surveys.

DAVENPORT, MIDDLEBURG & DURHAM.—J. H. Cornell, Middleburg, N. Y., writes us that this road will run from a point near East Davenport, N. Y., to Durham, N. Y., 60 miles, and that the surveys have been completed. The route is through a good timber and farming country, and the work will be generally light. About $60,000 have been subscribed in aid of the enterprise. Pres., Wm. H. Thorne, Middleburg, N. Y., and Ch. Engr., Comfort Bennell, Elmira, N. Y.

SOUTHBRIDGE, STURBRIDGE & BROOKFIELD.—This company has been chartered in Massachusetts to build the proposed railway from Brookfield to Southbridge, Mass., 13 miles. It is stated that construction will begin at once. Treas., Francis L. Chapin, Clerk, A. C. Moore.

TOMHICKEN, MILNESVILLE & EASTERN.—J. I. Hallenbeck, Milnesville, Pa., Ch. Engr., writes us that the surveys have been completed for this proposed railway from Tomhicken to Milnesville, Pa., 8 miles, and that contracts for construction will be let in about two weeks. The road is being built to give an outlet to the Milnesville Colliery and will do only a freight business. The route is through a rough, wooded country; maximum grade 1.5 per cent. and maximum curve 16°. It is expected that tracklaying will begin about July 1 and that the line will be completed by Sept. 1. The company was chartered April 27, 1892. A. S. Van Wickle is President.

NEW YORK.—A press dispatch says: "At Walton, N. Y., a meeting of citizens was recently held to decide on the best plan and route and probable cost of a competing railroad from the Hudson River to the coal fields via Andes, Delhi, Hamden, Walton, Rock Rift, Cannonsville and Deposit. The following committee was appointed: James Ballentine, Alexander Nelson, A. J. Combs, J. A. Page, J. A. White, O. T. Bundy, E. C. Inderlied, Alonzo Seymour, and Henry Inderlied. The proposed road will cross the Erie at Deposit and parallel the Jefferson branch of the Erie and the Scranton division of the Ontario & Western to Carbondale and Scranton. It will strike the Ontario & Western at Rock Rift and parallel its main line to the Walton & Delhi Branch of the Ontario & Western to Delhi. It will pass through a new territory from Delhi to near Arkville on the Ulster & Delaware, after which it will probably run very near it to the neighborhood of Kingston. The committee in charge are prominent men in Delaware and Broome counties, and seem to be thoroughly in earnest."

MINERAL RANGE, HANCOCK & CALUMET.—It is stated that a railway will be built from Calumet, Mich., south to Lake Linden, 3 miles, and that work will begin at once. Gen. Man., C. A. Wright, Hancock, Mich.

Southern.—Existing Roads.

OHIO RIVER.—The extension of this line to a connection with the Norfolk & Western R. R. will be 10½ miles long, and will be completed by Sept. 1.

LOUISVILLE & NASHVILLE.—Surveys have been completed for a branch from Worthville to Owenton, Ky., about 10 miles, and it is stated that construction will begin at once.

KANAWHA & MICHIGAN.—It is reported that an agreement has been entered into by the Kanawha & Michigan Ry. Co. and the Chesapeake & Ohio Ry. Co. by which the former company is to build a branch to a connection with the Chesapeake & Ohio Ry. at a point where the Gauley River empties into the Kanawha River.

Projects and Surveys.

CONCORD SOUTHERN.—W. M. Smith, Sec., Concord, N. C., writes us that surveys will soon begin for this railway from Concord, N. C., to a connection with the Carolina Southern R. R. The town of Concord has voted $75,000 in aid of the road.

BRUNSWICK, WESTERN & SOUTHERN.—Press dispatches state that work will soon begin on the section between Wilmington and Southport, N. C., 25 miles. There is probably but little foundation for the report.

TENNESSEE CENTRAL.—The towns of Trenton and Milan will soon vote on the proposition to subscribe $50,000 and $10,000 respectively in aid of this enterprise. This corporation was organized about 1870 and was pushed for some time by Col. Cole and Horace Scott, of Louisville, Ky. The line has been surveyed from Trenton to Florence, Ky., and 15 miles graded. It is stated that New York capitalists have become interested in the enterprise and will push the line to completion.

LOUISVILLE BELT.—It is stated that a number of Louisville, Ky., men are about to organize a company to build a belt railway at that place.

Northwest.—Existing Roads.

BURLINGTON, CEDAR RAPIDS & NORTHERN.—A press dispatch from Mason City, Ia., says: "The position which the Burlington, Cedar Rapids & Northern intends to occupy in this territory is a matter that is greatly interesting a large number of people throughout the northern part of the state. The company now owns and operates a line running from Granite in the extreme western part of the state through Lyon, Osceola and Dickinson counties. It has a line running north to Estherville, a division point on the Watertown branch, another to Manly, on the main line, and again at Decorah, the head of the Decorah division, and now it is announced that the company intends building from Estherville to Decorah, tying all these arms together, occupying a rich belt between the Minnetonka and Dakota divisions of the Chicago, Milwaukee & St. Paul R. R., and giving a connection to Minnetonka and the Dakotas that can only be had by running south to Cedar Rapids and thence northward."

WINONA & SOUTHWESTERN.—At the annual meeting of the stockholders of this company, recently held, it was decided to build at once the extension from Osage to Mason City, Ia., 25 miles.

DULUTH & IRON RANGE.—Is stated that this company will build several branch and switch lines in addition to the main branch now under construction from Mesaba Station, Minn., west. A newspaper notice of the work says: "There are five different branches to be built, marked on the map as the Western Mesaba Branch, the Cincinnati Branch, the Shaw Branch, the Merritt Branch, and the East Canton Branch, which will traverse through Lake and St. Louis counties. The surveys for these different lines have been quietly made and are almost in readiness for the contractor. Railroad shops, yards, depots, and other buildings are also to be built. The work will make a material change in the geography of that section of the country and build up one or more towns. A branch line will be extended into the town of Merritt, where shops and a depot will be built. The building of a branch line to the Shaw property is a little surprising, as this company has made a traffic contract with the Mesaba road. It is prob-

able, however, that the Iron Range will get the ore from the Shaw property leased by Kimberly, the Pennsylvania iron king. One of the branches will run up into this section 11, thus invading the territory of the Mesaba road. A gentleman interested, speaking to a Tribune reporter about the matter yesterday said: "This work is now well in hand and will be commenced at a very early day. By August I think the different lines will be completed and ready to take the ore from the mines. The Iron Range Co. has already ordered a large number of cars and several of the mining companies will shortly begin stripping, and getting ready for shipments. Notices of condemnation proceedings to acquire the right of way necessary for these lines will probably be filed to-day, and the hearing of the matter will come before the district court June 4 next.

PORT ARTHUR, DULUTH & WESTERN OF MINNESOTA.—This company has been chartered in Minnesota to build a railway from Ely, Minn., to connection with the Port Arthur, Duluth & Western R. R. on the international boundary.

TERMINAL & BELT LINE.—This company has let the contract for grading the remaining 2½ miles of its line from New Duluth to Allouez Bay, Minn., to Winston Bros., of Minneapolis, Minn. In addition to the 2½ miles of grading there is a large amount of trestle work. The contract price is $68,000.

Southwest.—Existing Roads.

MISSOURI, KANSAS & TEXAS.—It is stated that material is arriving for the extension of the Henrietta, Seymour & Pacific R. R. from Seymour to Benjamin, Tex., about 30 miles. The Southwestern Co., of Milwaukee, Wis., has been organized to build the extension east from Franklin, Mo., to a point east of St. Charles, Mo., 178 miles. The contracts for the grading and trackla ying have been awarded to Henry & Balch, of Jefferson City, Mo., and about 500 men are at work on the grading.

KANSAS CITY, NEVADA & FT. SMITH.—As noted last week, this line will probably be extended from Hume, Mo., south about 50 miles, this season. The preliminary surveys have been completed and it is announced that construction will be begun at once.

AUSTIN & NORTHWESTERN.—All but 10 miles of the 27-mile extension from Fairland to Llano, Tex., have been completed. The work has been somewhat slow on account of the large number of small gulches to be bridged.

Projects and Surveys.

ROCKPORT & HARBOR ISLAND.—John H. Traylor, Dallas, Tex., Pres., writes us that the surveys have been completed for this 10-mile road from Rockport to Harbor Island, Tex., and that nothing further will be done until deep water is secured at Harbor Island.

HOXIE & POCAHONTAS.—The officers of this company, whose incorporation was noted in our issue of April 28, are: Pres., Wm. D. Gentry, Chicago; V.-P., J. H. Moran, Walnut Ridge, Ark., and Sec. and Treas., R. D. Moran, Hoxie, Ark.

Rocky Mt. and Pacific.—Existing Roads.

KANSAS CITY, EL PASO & MEXICAN.—The announcement that this 10-mile railway from El Paso, Tex., north, had been purchased by the Gould interests, is verified, and it is stated preparations are already in progress for its extension north.

BURLINGTON & MISSOURI RIVER.—It is stated that this company has let the contract for an additional 25 miles of its Wyoming extension. The line was completed to Gillette, Wyo., last year, and 44 miles between that point and the Powder River are under construction. The new contract takes the line from the Powder River to Clear Creek, 69 miles beyond Gillette, Wyo.

GREAT NORTHERN.—Tracklaying on the Pacific extension has been completed between Kalispel, Mont., and Sand Point, Idaho, completing 437 miles of the line. Between Sand Point and Spokane, Wash., a gap of about 45 miles remains to be finished.

Projects and Surveys.

SALTAIR.—This company, which was organized to build a railway from Salt Lake City to Saltair Beach, 16 miles distant, has changed its name to the Salt Lake & Los Angeles Railway Co., and will, it is stated, push on to the coast. Fifty teams and a large force of men are now grading west of Salt Lake, and will reach Saltair Beach in two weeks. Sixty-pound steel rails have been ordered of the Colorado Coal & Iron Co., at Pueblo; cars have been ordered from eastern manufacturers, and a 45-ton engine is now building at the Rhode Island Locomotive Works. The company will build to the Deep Creek country from Saltair Beach, and then continue on to the coast. N. W. Clayton is Manager and Treasurer.

Foreign.

BOLIVIA.—The Government of Bolivia has invited proposals for the construction of a narrow gage railway from Oruro to La Paz, a distance of about 125 miles. The bids will be opened July 1. The construction company will have to furnish the capital, upon which an interest guarantee will be given by the Bolivian Government. The Antofagasta Railway is now completed to within 60 miles of Ouro, and will reach that city during the current year, and this new road will be practically a continuation of that line.

ELECTRIC RAILWAYS.

LYNN, MASS.—The Lynn & Boston Ry. Co. is now equipping its city and country lines with the electric system. It is intended to handle freight traffic.

SOUTHBRIDGE, MASS.—Southbridge, Sturbridge & Brookfield Ry. Co.; $130,000; Pres., F. L. Chapin; Secy., A. C. Moore.

ABINGTON, MASS.—Hatherly Electric Ry. Co.; $60,000; to build a line to Rockland, Whitman, etc. Secy., G. W. Kelley, of Rockland.

PROVIDENCE, R. I.—The Union Rv. Co. has been granted a franchise for 20 years, with permission to use electricity.

BATAVIA, N. Y.—An electric road to Oak Orchard is projected by D. S. Beckwith, of Buffalo.

LONG ISLAND CITY, N. Y.—The Steinway Ry. Co. has received permission to adopt the trolley electric system.

TAMAQUA, PA.—Tamaqua & Pottsville Electric Ry. Co.; 20 miles; $120,000, with $20,000 paid in. Pres., J. O. Ulrick.

LEWISTOWN, PA.—Lewistown & Bellefonte Electric Ry. Co.; 25 miles; capital, $400,000, with $50,000 paid in. Pres., W. P. Stevenson, McVeytown, Pa.

MECHANICSBURG, PA.—Susquehanna Ry. Co.; West Fairview to Mechanicsburg, 12 miles; capital, $75,000, with $15,000 paid in. Pres., D. D. Phillips, Gordon, Pa.

TAMPA, FLA.—The Tampa Street Railway & Power Co. has been organized by Mr. Ahern and others.

FORT WAYNE, IND.—The street railway company has adopted the electric trolley system, and has let a contract to the Fort Wayne Electrical Works for generators and motors.

KEOKUK, IA.—Gate City Electric Street Ry. Co.; $130,000. Pres., Wm. Logan; Secy., W. J. Roberts.

DULUTH, MINN.—Duluth & Northeastern Ry. & Terminal Co.; $1,000,000; electric railways. Pres., W. C. Sargent.

PORTLAND, ORE.—The Columbia Consolidated Ry. Co. has purchased 35 miles of horse railways, and will adopt electric traction.

SEATTLE, WASH.—The Northwest Thomson-Houston Electric Co., proposes to acquire all the electric railways of the city aggregating 50 miles.

SAN BUENA VENTURA, CAL.—Ventura & Ojai Ry. Co., 18 miles; $250,000. W. S. Chaffe, A. D. Barnard and G. W. Chrisman.

NIAGARA FALLS, ONT.—Proposals for the construction of a power house will be received until May 18 by W. T. Jennings, Consulting Engineer, Niagara Falls & River Ry.

CABLE RAILWAYS.

ORANGE, N. J.—The Orange Heights Land Co. has resumed work on the road to its property on the top of the Orange Mountains. The contract for the entire work has been awarded to John A. Roebling's Sons, of Trenton, N. J.

SAN FRANCISCO, CAL.—The Geary Street, Park & Ocean Ry. Co. is to change its system from steam to cable.

HORSE RAILWAYS.

NEWBURYPORT, MASS.—Peoples' Street Ry. Co., to West Newbury; $100,000; F. S. Carr, O. G. Chase and George Gilman.

HAVERHILL, MASS.—Haverhill & Amesbury Street Ry. Co.; $250,000; Chas. Goss, Adam Scott, and Albert W. Goss.

LOWELL, MASS.—Lowell, Lawrence & Haverhill Street Ry. Co.; $400,000; George A. Hall, A. B. Bruce and C. E. Adams.

NEW YORK, N. Y.—The New York, White Plains & Mamaroneck Ry. Co., $90,000, and the New York, Elmsford & White Plains Ry. Co., $60,000, have been incorporated to build roads, six and four miles long, respectively, in Westchester Co., by James H. Moran, James B. Lockwood and J. E. Campbell, of White Plains, and T. G. Gross and V. O. Krepps, of New York.

LONG ISLAND CITY, N. Y.—Crescent Ry. Co., six miles; $100,000. D. S. Jones and H. M. Werner, of Long Island City; J. Quinn, of Brooklyn, and W. Tuck, of New York.

INDIANAPOLIS, IND.—The sale which was arranged of the Citizens' St. Ry. to an Eastern syndicate, was broken off by the failure of the syndicate to furnish sufficient security for the bonds. Pres. J. P. Frenzell will continue to operate the lines by horses.

HIGHWAYS.

CONNECTICUT.—The Selectmen of Glastonbury have engaged an engineer, and will build at least one mile of macadamized road this season.

NEW YORK.—The town of New Utrecht will spend $150,000 in macadamizing the roads. This, with what work has already been completed, will cover all the roads of the town with macadam, at a cost of over $500,000.

MISSOURI.—The State Road Convention has elected permanent officers: Pres., Hon. C. F. Cochran, St. Joseph; Secy., Levi Chubbuck, Columbia.

BRIDGES, TUNNELS AND CANALS.

BLACKSTONE, MASS.—Cornelius, Day, Patrick Kennedy and Wm. A. Power have been appointed a committee to get plans and receive bids for the $18,000 stone arch bridge to replace the one recently burned.

SUFFIELD, CONN.—The Suffield-Thompsonville B'dge Co. has been organized for the purpose of constructing a bridge over the river between this city and Thompsonville. C. H. Briscoe, of Thompsonville, and Chas. D. Woodworth, of Suffield, are interested, and can give information.

ROCHESTER, N. Y.—Chairman of Public Works will give details of bridge to be built at Mortimer St. and also one at Andrew St.

WILMINGTON, DEL.—City has been authorized to issue $5,000 bonds to build a bridge over the Brandywine.

BELLEVUE, PA.—A bridge is to be built at once at Jack's Run, a short distance from here, by which the electric cars from Pittsburg will reach this place.

COLUMBIA, PA.—The Pennsylvania R. R. Co., Wm. H. Brown, of Philadelphia, Pa., Ch. Engr., will construct an overhead bridge at this place. No contracts have yet been let.

FRANKLIN, PA.—An iron bridge is to be erected over the Western Branch of the Conocheague Creek, near Rider's mill, to cost $2,000.

SHOEMAKERVILLE, PA.—$10,000 will be spent for raising the bridge at this place.

WEST PENN, PA.—The Livermore 4-span bridge and the Buffalo Creek bridge at Buffalo June. are to be immediately replaced by iron ones.

CHILLICOTHE, O.—John A. Somers, Auditor of Ross Co., will receive sealed proposals until May 16, for building a bridge over the Buckskin Creek at Linden.

COLUMBUS, O.—Henry J. Caren, County Auditor, will receive proposals until May 31, for building a bridge over the Big Walnut Creek, in Truro Township.

MARION, O.—A new iron bridge will be built at Caledonia, Marion Co., Marion, C. H.

BATAVIA, O.—The contract for the masonry for the bridge across Clover Creek near the mouth of said creek and on the Williamsburg and Bantam Pike will be let on the grounds where the bridge is built May 28. Plans and specifications made known on day of sale. John W. Davis, Aud., Clermont Co.

LEXINGTON, VA.—The Lexington Development Co., J. D. Ross, Pres., contemplates erecting an iron bridge over Woods Creek here.

RIVERTON, VA.—Proposals will be received by Samuel Carson until June 1 for the stone work and superstructure for two iron bridges across the Shenandoah River. Plans, specifications, etc., can be obtained from F. B. Morse, Engineer, Front Royal, Va.

GRAFTON, W. VA.—The Baltimore & Ohio R. R. will erect a bridge to connect the tracks of the Grafton & Green Brier R. R. with its main line at this point.

SUTTON, W. VA.—The West Virginia & Pittsburg R. R. will erect an iron bridge over Elk River.

WESTON, W. VA.—The West Virginia & Pittsburg R. R. Co., general offices in this city, will construct an iron railway bridge over the Elk River at this place.

HARRIMAN, TENN.—A bridge is to be built across the Emory River. It will consist of two spans, one 100 ft., and the other 200 ft. There will be one abutment and two sets of iron tubes. The King Bridge Co. has the contract for the iron work, and local parties the contracts for approaches and masonry. Mr. J. P. Suverprop, Ch. Engr. of the East Tennessee Land Co., will have charge of the bridge.

CORTLAND, MINN.—Sealed proposals will be received until May 14 for the construction of a bridge in township 109, Section 24. H. Froehloch, County Clk.

KANSAS CITY, KAN.—The County Commissioners will have plans prepared for the reconstruction of the Kansas Ave. bridge. No contracts have yet been let.

SALINA, KAN.—The County Commissioners have appropriated $2,000 each for a bridge at Smoky River at Walnut St., and one at Ash St. It will be necessary for the city to appropriate $1,000 for each bridge.

WATER-WORKS.

New England.

OLD ORCHARD, ME.—It is reported that the Old Orchard Water Co. has bought additional land and springs and will at once erect a new pumping station and build a new reservoir.

ROCHESTER, N. H.—The appropriation of $4,100 for the extension of water mains has been recommended.

BOSTON, MASS.—The sum of $40,000 has been appropriated for investigations for a new supply.

CHICOPEE, MASS.—New sources of supply are being investigated, with E. C. Davis, Northampton, as engineer.

LAWRENCE, MASS.—At the meeting of the Water Board, at which filtration was to be discussed, May 6, it was resolved to ask advice from the State Board of Health. It seems likely that filter beds, if anything, will be adopted.

MALDEN, MASS.—It is reported that the Water dence, R. I., has been engaged as engineer by the Board has visited Martin's Pond, in North Reading, to consider the introduction of a new supply from this source; also that a filter bed is talked of.

STOUGHTON, MASS.—It has been decided to draw a temporary supply for the new town works from the Drake schoolhouse reservoir. J. Herbert Shedd, Providence, R. I., has been engaged as engineer by the Commissioners.

YARMOUTH, MASS.—It is reported that the Town Council is discussing the advisability of building works.

EAST PROVIDENCE, R. I.—Bids are wanted by the fire district until May 14 for $200,000 of 4 per cent. gold water bonds. Address Benjamin Wilson, Rumford, R. I.

PROVIDENCE, R. I.—It is proposed to appropriate $100,000 for construction.

FAIRFIELD, CONN.—Works are talked of, with a possible supply from a reservoir on Mill River.

NEW LONDON, CONN.—Supt. W. H. Richards has been instructed to make preliminary surveys for an additional supply. Meters will be applied to all large consumers where not now in use.

SHELTON, CONN.—The Shelton Water Co. has voted to increase its capital stock from $25,000 to $50,000.

Middle.

ALBANY, N. Y.—The mayor recommends an increase of the Hudson River supply and filtration. Additional pumps were bought some time ago.

EAST SYRACUSE, N. Y.—The village has voted for works estimated to cost $50,000. Surveys will soon be made. Geo. Weaver, Wm. Fry and others are Water Commissioners.

NEWBURG, N. Y.—Engr. John D. Van Buren will make surveys for the addition of the water of another stream to the supply.

NEW YORK, N. Y.—Bids will be received until May 17 by the Commissioner of Public Works for laying water mains in several streets.

TICONDEROGA, N. Y.—A special election will be held to vote on issuing bonds for town works. A company built works in 1875.

YONKERS, N. Y.—The Governor has signed a legislative bill authorizing the issuance of $300,000 of bonds for improvements to the works.

BELVIDERE, N. J.—It is rumored that a new company may be organized.

HOP BOTTOM, PA.—The Hop Bottom Water Co. was incorporated May 4; Treas., Geo. B. Jermyn, Scranton; capital stock, $15,000.

PHILADELPHIA, PA.—Council's Water Committee has voted to recommend to the Council that bids be asked for a 20,000,000-gallon filtering plant at the Belmont pumping station. Bidders must propose to operate the plant successfully one year at their own expense and must have a plant in operation elsewhere. The ordinance providing for a contract with the Pennsylvania Filtering Co. for a plant at Lardner's Point, at a cost of $150,000, 90 per cent. to be paid before the completion of the plant, was unfavorably considered and finally withdrawn.

WRIGHTSVILLE, PA.—Application will be made May 27 by P. D. Wanner, A. H. Mellert and others for the incorporation of the Wrightsville Water Co.

Southern.

ALBANY, GA.—Bids are wanted by the city until June 1 for 1,150 tons of 12 to 4-in. pipe, 88 valves and other material, as stated in our advertising columns; also for $100,000 of 6 per cent. city bonds. W. H. Gilbert, Mayor; John C. Chase, Engr., Wilmington, N. C.

MADISON, FLA.—Works are projected.

ALEXANDRIA, LA.—An opportunity to secure a franchise is still open, according to the "Times."

HOPKINSVILLE, KY.—The Council has accepted a proposition for the building of works from John P. Martin, Xenia, O.

LINCOLN, KY.—It is reported that works are almost a certainty.

LUDLOW, KY.—At a recent public meeting the Council was requested to call an election to vote on the issuance of $25,000 of bonds for works with a supply bought from Covington. Address R. H. Flemming or L. P. Bentley.

NICHOLASVILLE, KY.—John F. Geary, Lexington, has been considering the introduction of water here.

North Central.

CLEVELAND, O.—Bids are wanted until May 25 for furnishing and delivering on the streets 11,460 ft. of 36-in. cast iron pipe, with necessary specials; also for such 16-in. pipe and specials as may be needed this year. R. Herrick, Director Pub. Wks.

GREENVILLE, O.—Moffett, Hodgkins & Clarke have offered to build works as follows: A supply developed in either the Mud or Greenville Creek Valley; pumping stations and water tower; ten miles of mains and 125 hydrants; franchise to run 25 years with privilege of purchase by the city after ten years; $5,500 yearly revenue to be paid by city.

NAPOLEON, O.—The people voted, May 3, 309 to 154, for water and electric lighting plants, to be owned by the town.

CANNELTON, IND.—W. W. Taylor, representing the American Pipe Manufacturing Co., Philadelphia, has been investigating the building of works here.

RUSHVILLE, IND.—It is reported that an effort to secure works will be made.

L'ANSE, MICH.—It is reported that water will be introduced from Fall River, from a point 250 ft. above the bay.

SPARTA, MICH.—The company, it is said, is about to put in 8,000 ft. of additional mains and eleven hydrants.

MONTICELLO, ILL.—It is reported that works will be constructed at an estimated cost of $30,000, and that the Mayor can give detailed information.

SHULLSBURG, WIS.—It is reported that the people will soon vote on the building of works.

Northwestern.

WOODBINE, IA.—A citizens 'meeting has been held to discuss the introduction of water.

BROWNS VALLEY, MINN.—A contract for city works has been let. There will be a well 8 ins. in diameter and 900 ft., if necessary, in depth. A well already sunk is satisfactory.

Southwestern.

EAGLE PASS, TEX.—It is reported that new pumps and mains will be added.

LLANO, TEX.—The Llano Improvement & Furnace Co. will receive sealed proposals until May 23 for the construction of water-works at New Llano,

CRIPPLE CREEK, COLO.—It is reported that Irving Howbert, B. Crowell and J. A. Hayes of Colorado Springs, are organizing a company to conduct water from Beaver Park to Fremont; also, that pipe has been ordered and surveys for the conduit have been made.

DURANGO, COLO.—The mains will be extended to North Durango.

Pacific.

KENT, WASH.—The Council has voted to submit to the people the question of buying two private water and an electric lighting plant for $15,500 and expending $9,500 for a pump, 100,000-gallon tank at a 200-ft. elevation, and new mains.

TACOMA, WASH.—It is reported that the Tacoma Light & Water Co. will lay 22 miles of mains this year, some of it ranging from 24 to 10 ins. in diameter. Some, or all of the pipe, has been bought. R. B. Mullen has bought and will lay six miles of mains in connection with his North End works.

ATHENA, ORE.—The Council has voted to issue bonds for works.

HOOD RIVER, ORE.—The Hood River Water Co. has been incorporated by E. L. Smith, F. H. Button and S. J. LaFrance to distribute water from the Hood River for domestic and manufacturing purposes; capital stock, $20,000.

ONTARIO, CAL.—The Trustees have voted to call an election to decide whether $12,000 of bonds shall be issued for improvements to the town water system.

SAN DIEGO, CAL.—The Water Committee of the two branches of the Council have voted in favor of having the City Engineer estimate the cost of a city distributing system. The city now leases private works.

MIDWAY, UTAH.—There is some talk of introducing a supply from springs near by. The cost, it is said, would be small.

Canada.

PERRY SOUND, ONT.—Bids for building works are wanted by W. L. Haight, Town Clerk, until May 24. Consult. Engr., John Galt, Toronto.

REGINA, N. W. T.—It is reported that the building of works is being seriously discussed.

ARTESIAN WELLS.

SAN ANGELO, TEX.—A well is proposed by some of the business men

ATHENA, ORE.—The sum of $2,000 has been appropriated for sinking an experimental well.

IRRIGATION.

ELLENSBURG, WASH.—A ditch about 70 miles long, circling the entire valley, is talked of.

KENNEWICK, WASH.—The first ditch of the Yakima & Kennewick Irrigation Co., is reported as over half completed, the proposed length being 30 miles. Construction of a second, a high line ditch, has just been started. Water will be taken from the Yakima River at Prosser's Falls, 16 miles above the head of the first ditch. At Rattlesnake, Mont., the ditch will divide, to supply 100,000 acres at the north and 60,000 acres at the south. The south branch will cross the Columbia River by means of a wooden flume, and will extend to Kennewick. C. H. Leadbetter, V.-P.

SEWERS.

ELLSWORTH, ME.—At the next regular meeting of the Council a vote will be taken upon authorizing the Mayor to employ an engineer to prepare surveys and estimates for a system of sewerage.

BOSTON, MASS.—The lowest bid for section 27 in Somerville and Cambridge was that of McGovern & Kitch, $55,240. We shall publish the list of bids next week.

FITCHBURG, MASS.—It is proposed to construct a system of sewers in the East Fitchburg district.

HAVERHILL, MASS.—The City Engineer is preparing plans for sewers for the districts about Walnut and Dustin Squares. It is expected that two systems will be required.

MELROSE, MASS.—W. F. Morse and four others have been appointed a committee to act with the Board of Selectmen in investigating the question of sewerage, and to report at the next fall meeting.

NANTUCKET, MASS.—J. S. Barney, W. H. C. Lawrence and W. F. Todd have been appointed Sewer Commissioners.

SOMERVILLE, MASS.—The Council has voted in favor of borrowing $10,000 for sewers.

WORCESTER, MASS.—The Committee on Sewers has decided to build ten additional tanks at the purification works at Quinsigamond, at an estimated cost of $80,000.

PROVIDENCE, R. I.—The Board of Aldermen has passed resolutions for sewers in six streets.

BUFFALO, N. Y.—The City Engineer hopes to have a plan completed by June 1 for sewers for Kensington.

HOLLEY, N. Y.—Bids are asked until May 16 for sewers in four streets. W. S. Housel, Village Clerk.

OLEAN, N. Y.—The citizens have voted almost unanimously in favor of the $35,000 asked for the construction of outlet sewers.

TARRYTOWN, N. Y.—The village has voted to issue bonds for $10,000 to complete the system of sewerage.

TROY, N. Y.—The Council has adopted the recommendations of the committee in favor of 18-in. tile and 26 2-3x40-in. brick sewers each in two streets.

JERSEY CITY, N. J.—Bids are asked until May 16 for sewers for the Catholic cemetery: 3,500 ft. of 10-in. pipe; 1,400 ft. of 12-in.; 600 ft. of 15-in.; 700 ft. of 18-in.; 1,050 ft. of 20-in.; 20 manholes, and 45 basins. Rev. B. H. Ter Woert, 46 Nelson Ave.

ELIZABETH, N. J.—The Street Commissioner has been authorized to ask bids for sewers in two streets.

NEWARK, N. J.—The Street Commissioners have voted to construct 12-in. pipe sewers in three streets, 15-in. in two, 18-in. in one street, and a 30x20-in. brick sewer in two streets.

KITTANNING, PA.—The town has voted to issue bonds for $30,000 for a system of sewerage.

OIL CITY, PA.—Bids are asked until May 23 for two sewers. H. H. Culbertson, City Controller.

READING, PA.—The Pennsylvania Sanitary Co. offers to put in the West system for $8,500 a mile for the first 20 miles and $5,000 a mile thereafter. This would include a pumping station and filter beds for the sewerage of 100,000 people. The estimate of C. P. Bassett, Newark, N. J., for a system is $165,000. G. E. Waring, Newport, R. I., was invited to appear before the committee May 7.

WILKINSBURG, PA.—The citizens have voted in favor of issuing bonds for $160,000 for the proposed sewers.

WILMINGTON, DEL.—Two contracts have been awarded to Haycock & Siddall, at $39,355.

BALTIMORE, MD.—Bids are asked until May 18 for the material for three sewers. A. E. Smyrk, Cy. Comr.

HAGERSTOWN, MD.—The city has voted to issue bonds for $40,000 for sewers and streets.

THOMASVILLE, GA.—The main sewer is to be extended two miles.

OCALA, FLA.—The Council is discussing the advisability of employing an expert engineer to prepare plans for a system of sewerage. The cost is estimated at from $40,000 to $80,000.

MERIDIAN, MISS.—The city will vote July 30 upon the issue of bonds for $75,000 for a system of sewers.

COVINGTON, KY.—The Council has voted in favor of sewers in five streets.

CLEVELAND, O.—Bids are asked until June 1 for sewers in four streets. R. R. Herrick, Director Pub. Wks.

CLEVELAND, O.—The city is considering plans for a 7-ft. sewer in Doan St. from Euclid Ave. to the lake. This will pass through Glenville, and a joint committee has been appointed by the city and village to consider the matter.

DAYTON, O.—Bids are asked until May 19 for 710 ft. of 42-in. and 170 ft. of 30-in. brick sewer. C. A. Herbig, City Comptroller.

NAPOLEON, O.—The Council is preparing plans for a brick sewer from Scott St. to a creek a mile distant.

COLUMBUS, O.—Bids are asked until May 17 for brick and pipe sewers. F. M. Senter, Clk. Bd. Pub. Wks.

FINDLAY, O.—Bids are asked until May 26 for one sewer: 1,558 lin. ft. of 24-in. single ring brick; 675 ft. of 20-in. vitrified pipe; 360 ft. of 8-in. pipe, and 8 manholes. J. E. Humphrey, Cy. Engr.

YOUNGSTOWN, O.—Bids are asked until May 17 for several sewers. H. W. Calvin, Clk., Cy. Comrs.

FORT WAYNE, IND.—The Council has voted to construct sewers in five streets.

LANSING, MICH.—The Mayor advises the Committee on Sewers to consider the feasibility of a complete system of sewers instead of the customary "patch work" construction.

PEORIA, ILL.—The Council has voted to construct sewers in several streets.

RHINELANDER, WIS.—Preliminary surveys for a system are being made by Edgar Williams, Chicago. A special election will soon be held to vote upon the construction.

CRESTON, IA.—Bids are asked until May 16 for 1,808 lin. ft. of 20-in. salt glazed vitrified pipe sewer, 2,835 ft. of 18-in., 360 ft. of 12-in., also manholes, branches, etc. I. S. Roseberry, Cy. Engr.

ST. JOSEPH, MO.—The City Engineer is preparing plans for a proposed extension of the Mitchell Ave. sewer, to cost about $30,000.

OGDEN, UTAH.—A contract has been awarded to Hobson & Wilkerson at $9,500. The highest bid was $22,270.

PORTLAND, ORE.—At a meeting of the Southeast Portland Improvement Association, April 30, the Superintendent of Streets reported that the proposed big sewer from Hawthorne Ave. and Twelfth St. would cost $200,000, and drain 2,100 acres. Two other plans were reported: a 24-in. terra cotta sewer that would cost $50,000, but would not carry storm water, and a 5 to 7-ft. brick sewer that would cost $85,000 and drain 600 acres.

SANTA ANA.—The Board of Trustees has been petitioned to take immediate steps for the construction of a system of sewerage. The expense is estimated at from $20,000 to $70,000.

SANTA MONICA, CAL.—The question of a sewerage system is being discussed and it is reported that bonds will be issued for the immediate construction of the outfall sewer.

LLANO, TEX.—Bids are asked until May 23 for a sewerage system for New Llano. F. R. Malone, Pres. Llano Improvement & Furnace Co.

MONTREAL, QUE.—Bids are asked until May 18 for sewers in seven streets. P. W. George, Cy. Surv.

STREETS.

FALL RIVER, MASS.—The Committee on Finance has recommended a loan of $95,000, of which $20,000 is for paving.

NEW YORK, N. Y.—The Department of Public Parks asks bids until May 18 for 9,000 cu. yds. of screened gravel. The Department of Public Works asks bids until May 17 for paving five streets with granite blocks on concrete, and three with asphalt on present stone block pavement.

TROY, N. Y.—The Committee on Streets has reported in favor of paving two streets with granite blocks, and one street each with asphalt and vitrified brick.

RIDGEWOOD, N. Y.—The city has voted $30,000 for macadamizing the streets.

CAMDEN, N. J.—The Council has voted to pave three streets with rubble.

JERSEY CITY, N. J.—Bids are asked until May 16 for 80,000 cu. yds. of excavation and 15,000 sq. yds. of telford paving in the Catholic cemetery. Henry Ter Woert, 46 Nelson Ave.

NEWARK, N. J.—The Board of Street Commissioners has voted to pave seven streets with asphalt, and three with granite blocks.

RIVERTON, N. J.—Bids are asked until May 16 for 6,000 ft. of crushed bluestone sidewalk, 4 ft. wide and 4 ins. thick. H. Parry, Town Clk.

CURWENSVILLE, PA.—The City Council is discussing the question of brick paving.

ALEXANDRIA, VA.—It is proposed to pave King St. with Belgian blocks. The expense is variously estimated from $42,000 to $84,000.

WILMINGTON, N. C.—The Board of Aldermen has appropriated $25,000 for macadamizing Red Cross St.

CHATTANOOGA, TENN.—The city has on hand $107,983 for street improvements, and it is said that by the close of the summer every important street will be paved.

MEMPHIS, TENN.—The City Engineer has prepared estimates for the paving of 11 streets.

DAYTON, O.—Bids are asked until May 16 for cement or asphalt sidewalks; 23 contracts. C. A. Herbig, City Comptroller.

COLUMBUS, O.—The contract for paving Oakwood Ave. with Trinidad asphalt has been awarded to A. G. Pugh & Co The estimated cost is $31,056.

TIFFIN, O.—Bids for paving will be received until June 3 by Jerimiah Rex, Cy. Clk.

FORT WAYNE, IND.—The Council has voted in favor of a large number of street improvements, including brick sidewalks in 17 streets.

GRAND RAPIDS, MICH.—The following estimates have been adopted: Paving East Fulton St. with blocks $17,962; cedar blocks on concrete, $10,899; brick on concrete, $20,236, asphalt on concrete, $24,544.

MONMOUTH, ILL.—Contracts have been awarded to W. W. McCullough at about $57,000, and Thatcher & Wilson at about $30,000.

ARANSAS HARBOR, TEX.—J. H. Drummond informs us that the streets are being paved with shells and clay, which form a material approaching concrete, and costs about 70 cts per sq. yd.

MONCTON, N. B.—The city has contracted for 1,800 lin. ft. of asphalt sidewalks. Wooden block pavement is to be laid as an experiment.

ELECTRICAL.

CHICOPEE, MASS.—The Council has voted to advertise for bids for street lighting unless the electric light company will renew the contract at $70 a lamp. The company offers to furnish lights at $77.50 per lamp for the present number, or $70 if the city will take 100 lamps.

NEWPORT, R. I.—A new electric light company has been organized. Pres., T. A. Havemeyer; Treas., G. B. Reynolds; Secy., H. W. Darling.

VAN WERT, O.—The Citizens' Electric Light Co.'s plant has been sold for $19,500 to Gen. A. V. Rice, Ottawa, who will improve and enlarge the plant.

COLUMBUS, IND.—A company is being organized to furnish light, and also power for an electric railway. It is proposed to construct a dam across the White River, six miles distant, and transmit the current to the city.

NASHVILLE, TENN.—Bids are asked until May 25 for not less than 350 lights of 2,000 c. p. Bd. Pub. Wks.

JACKSON, MICH.—The Council is reported about to advertise for bids for street lighting. The appropriation is $14,000.

CHICAGO, ILL.—Bids will be received until May 16 for supplying incandescent lighting for the buildings of the World's Columbian Exposition. D. H. Burnham, Chief of Construction, Rookery Building.

PEKIN, ILL.—The contract for street lighting has been awarded to the Pekin Electric Light & Power Co., at $77.50 till 3 a. m., or $80 per light for all-night lighting.

BROWN'S VALLEY, MINN.—An electric lighting plant is under consideration, the power to be furnished by a turbine run by the new artesian well.

BARNUM, COLO.—A committee has been appointed to secure electric lighting for the town.

WAITSBURG, WASH.—A franchise has been granted and a plant to cost about $12,000 will be erected at once.

LA GRANDE, ORE.—A franchise for 20 years has been granted to the La Grande-Edison Electric Light Co. It is intended to double the present capacity of the plant.

LLANO, TEX.—Bids are asked unti May 23 for a lighting plant for the town of New Llano. F. R. Malone, Pres. Llano Improvement & Furnace Co.

LACHINE, QUE.—The contract for a 50-arc light dynamo of 1,200 c. p., 650 incandescent light dynamo of 16 c. p. 100 HP. Corliss condensing engine, and 100 HP. steel boiler has been awarded to the Edison General Electrical Co., at $14,200, including three extra armatures for incandescent dynamos. The town will furnish the building.

NEW COMPANIES.—Canton Electric Light, Heat & Power Co., Canton, Pa.; $10,000; Treas., J. W. Parsons. St. Croix Falls Light, Power & Telephone Co., St. Croix Falls, Wis.; $3,000; J. W. Mueller, J. Leery, F. B. Dorothy. American Battery Co., Chicago, Ill.; $1,000,000; G. F. Moore, C. E. Kaufmann, S. E. Hibben.

CONTRACT PRICES.

SAND AND STONE.—Philadelphia, Pa.—The following contracts have been awarded by Maj. C. W. Raymond, U. S. Engineer Office: 700 cu. yds. sand, delivered on Pea Patch Island, Del., Philadelphia Transportation & Lighterage Co., 80 cts. per cu. yd.; 108 cu. ft. of granite, having 275 sq. ft. of dressed surface, also for Pea Patch Island, Lieper & Lewis, Chester, Pa., $1.77 per sq. ft.; 400 cu. yds. sand to be delivered at the fort opposite Fort Delaware, F. C. Somers, Camden, N. J., 75 cts. per cu. yd.; 800 cu. yds. broken granite, trap or limestone, for the same fort, Irvine & Carty, Philadelphia, $1.98 per cu. yd.

STREET WORK.—Louisville, Ky.—Contracts have been awarded to Shanks & Tyler, paving with granite, $8.75 per square of 100 ft., and to J. R. Gleason, paving with vitrified brick, $8.90 per square.

Westfield, Mass.—The contract for paving Elm St. with granite blocks has been awarded to Hudson & Chester Granite Co., at $1.62½ per sq. yd.

San Francisco, Cal.—The contract for paving East St. with basalt blocks has been awarded to W. C. Rausch at 18⅝ cts. per sq. ft. for blocks and 6¾ cts. per lin. ft. for curbing.

Omaha, Neb.—The contract for paving Leavenworth St. with asphalt has been awarded to Andrew Jacks, Chicago, at $2.87½ per sq. yd. The Barber Asphalt Co. bid $3.12. A contract for paving with red Colorado sandstone has been awarded to Hugh Murphy at $2.20 per sq. yd.

Indianapolis, Ind.—We are informed by H. A. Mansfield, City Engineer, that five contracts have been awarded to the Western Paving & Supply Co., at the following prices: Asphalt, including grading and 6-in. concrete, $2.80 to $2.85 per sq. yd.; curbing, 70 cts. per lin. ft.; 4x18 in. stone, next to car track, 40 cts. per lin. ft.; repairing catch basins, etc., 5 to 10 cts. per lin. ft.

Chattanooga, Tenn.—A contract has been awarded to the Southern Construction Co., at $2.18 per sq. yd., for paving with Robbin's brick, and $2.31 for Hallwood blocks on concrete.

Wilmington, Del.—Seven contracts for grading have been awarded at from 10 to 30 cts. per cu. yd. Other contracts were at the following prices: Resetting curb, 14½ cts. per lin. ft.; gutter paving, 22 cts. per sq. yd.;

STREET SUPPLIES.—Irvington, N. J.—The contract for mountain stone for street work has been awarded to Lighthipe & Son, at $2.25 per ton. The contract for furnishing and laying bluestone for sidewalks was awarded to Thomas O'Reilly, at 15 cts. per sq. ft.

Wilmington, N. C.—The contract for stone for macadamizing Market St. has been awarded to Edgar Parmele at $2.30 per ton of 2,240 lbs. for New York stone.

SEWER.—Worcester, Mass.—The Sewer Committee has awarded contracts as follows: Brookfield Brick Co., brick, $7 per M.; Junction Foundry Co., manhole rings and covers, $7.85; catch basin castings, 1½ cts. per lb.; F. E. Powers, cement, $1.02 per bbl. in lots of 4,000 bbls., on the cars, and $1.07 in lots of 1,000 bbls., to be delivered at the works.

SEWERS.—Racine, Wis.—We are informed by C. F. Kohlmann, Cy. Engr., that three contracts have been awarded to N. F. Reichert, Racine, at the following prices: 22-in. pipe, 86 cts. per lin. ft.; 15-in., 12-in., 10-in. and 8-in., 80 cts., 75 cts. and 80 cts., respectively, for the different sewers; manholes, $40 each; flush tanks, $90; catch basins, $35; lampholes, $2.50 and $2; concrete, $7 per cu. yd.

WATER-WORKS SUPPLIES.—Grand Rapids, Mich.—A contract for 26,000 ft. of water pipe has been awarded to the Lake Shore Foundry Co., Cleveland, O., at $25 per ton for the pipe and 2½ cts. per lb. for the special castings.

Peabody, Mass.—The Water Board has awarded the contract for 6-in. cast iron pipe, 30 lbs. to the foot, to Davis & Farnham, Waltham, at $27.70 per ton of 2,240 lbs. D. B. Lord was awarded the contract for furnishing and laying 4-in. cement pipe, at 58 cts. per lin. ft., and for laying the 6-in. pipe, 36 cts. per ft. Mr. Lord offered to furnish and lay 6-in. cement pipe at 72 cts. per ft., and 6-in. iron at 78 cts.

MISCELLANEOUS.

DREDGING.—Washington, D. C.—Bids are asked until May 20 for dredging at the League Island Navy Yard. N. H. Farquhar, Chief of Bureau of Yards and Docks.

DIKES.—Philadelphia, Pa.—Bids are asked until June 6 for constructing both pile and earth dikes at the mouth of the Schuylkill River; two contracts. Maj. C. W. Raymond, U. S. Engineer Office.

STONE.—Portland, Me.—Bids are asked until May 23 for completing a stone wharf and depositing stone at the mouth of the Kennebunk River. Lieut.-Col. P. C. Hains, U. S. Engineer Office.

STEEL PLATES, LUMBER, ETC.—Washington, D. C.—Bids are asked until May 17 for 54,000 lbs. of steel plates, also lumber, bolts, pipe, etc., for the Norfolk Navy Yard; also for lumber, cement, sand and stone for the League Island Navy Yard. Edwin Stewart, Paymaster General, U. S. N.

PUBLIC BUILDINGS.—Washington, D. C.—The Senate has voted $50,000 for a public building at Charlottesville, Va. Bids are asked until May 27 for the erection and completion of the public building at Houlton, Me.; also for the excavation and temporary drainage of the one at Mankato, Minn. W. J. Edbrooke, Supervising Architect, Treasury Dept.

LIFE-SAVING STATION.—Washington, D. C.—Bids are asked until May 17 for the construction of a life-saving station at the World's Columbian Exposition. S. I. Kimball, Gen. Supt., U. S. Life-Saving Service, Treasury Dept.

DAM AND CANAL.—Llano, Tex.—Bids are asked until May 23 for a granite dam 26 ft. high across the Llano River, and a water power canal, in the town of New Llano. F. R. Malone, Pres. Llano Improvement & Furnace Co.

ABUTMENTS.—Bellevue, Kan.—Proposals will be received until May 19 for building four abutments and four culverts. C. W. Locke, Township Clerk.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Rhode Island Locomotive Works, Providence, R. I., have an order for three double-truck, four-cylinder compound locomotives for the Mexican Central Ry. These engines have been described and illustrated in Engineering News. H. K. Porter & Co., Pittsburg, Pa., have built five narrow gage engines for the U. S. of Colombia. The Manchester Locomotive Works, Manchester, N. H., are building locomotives for the Boston & Maine, the Old Colony and the Concord & Montreal.

CARS.—The Pullman Palace Car Co., Chicago, Ill., has an order for 25 passenger cars, 10 baggage, 10 express and 10 mail cars, also 1,000 box, 100 fruit, and 400 gondola coal cars of 60,000 lbs. capacity, all for the Norfolk & Western. The Wagner Palace Car Co. is building 100 sleeping cars for the New York Central. The Duluth Mfg. Co., Duluth, Minn., has an order for 200 ore cars for the Duluth, Mesaba & Northern. The Jones Car Works, Troy, N. Y., are building eight open cars for the Troy & Lansingburg.

RAILS.—The New York Central has received 3,000 tons of 100-lb. rails from the Lackawanna Iron & Steel Co., Scranton, Pa.

ELECTRIC HEADLIGHTS.—The Philadelphia & Reading is trying a headlight of the National Electric Headlight Co., Indianapolis, Ind.

CREOSOTING WORKS.—The Galveston Creosoting Works, Galveston, Tex., are treating large quantities of timber for use on the wharves, piers and docks at Galveston.

HOLLOW STAY BOLTS.—In the recent order of 100 locomotives, given by the New York Central R. R. to the Schenectady Locomotive Works, Schenectady, N. Y., it was specified that the hollow staybolts, made by the Falls Hollow Staybolt Co., of Cuyahoga Falls, O., should be used. These staybolts were described in our issue of May 16, 1891.

THE INGERSOLL-SERGEANT DRILL CO. has opened on office at 100 West Washington St., Chicago, Ill., with Parker, Melcher & Ingraham in charge. A full line of drilling, mining and quarrying plant will be kept in stock.

THE BERLIN IRON BRIDGE CO., East Berlin, Conn., has the contract for a new rolling mill for the Waterbury Brass Co., Waterbury, Conn. It will be a fireproof building, 150 by 350 ft., with brick side walls and iron roof trusses covered with the Berlin Bridge Co.'s patent anti-condensation corrugated iron roof covering.

THE NORTHWESTERN EQUIPMENT CO., Chicago, Ill., manufacturing the Kewanee rectangular brake beam, has removed its office to the Monadnock Building. Pres., M. S. Frost; Vice-Pres. and Man., E. I. Frost; Supt., C. L. Sullivan.

THE UNION BRIDGE CO., New York, announces that Gen. Geo. S. Field has retired from partnership, his "good will" remaining with the other partners, C. Macdonald C. S. Maurice and Edmund Hayes, by whom the business will be continued under the present name.

THE JACKSON BRIDGE & IRON CO. has been organized and will establish works at Jackson, Mich. Pres., J. H. Sairs; Vice-Pres., H. Maasberg; Secy., T. H. Scott; Engr., W. J. Reed. Capital stock, $100,000. The officers were formerly connected with the Wisconsin Bridge & Iron Works, at Wauwatosa, Wis.

F. J. McCAIN & BRO., Chicago, Ill., have erected 23 of the 46 arches of the Machinery Hall, World's Columbian Exposition; have been awarded the contract for erecting about 1,300 tons of structural iron for the Chicago & South Side Rapid Transit Co., and for erecting the new trainshed at St. Louis, Mo., full descriptions of which have appeared in Engineering News. They have recently completed the Ogden Ave. viaduct at Chicago, and one of three bridges to be erected at Coshocton, O.

SHOPS.—The Chicago, St. Paul & Kansas City R. R. Co. will build repair shops and a round house at Maywood, Ill.

STEEL WORKS.—The Tennessee Coal, Iron & Railroad Co. will have plans drawn for two steel plants, at Bessemer and Ensley City.

NEW COMPANIES.—Standard Compound Engine Co., Chicago, Ill., $150,000; J. H. Kinsel, John D. Bancroft and D. Carskaden. U. S. Asphaltum & Development Co., East St. Louis, Ill.; $1,000,000; H. A. Thompson, W. B. Long and H. W. Adams. Chicago Pure Aluminum Co., Chicago, Ill., $100,000; W. P. Rounds. (Rookery Building, Chicago), C. G. Daniels and C. A. Taylor, Jr. Acme Car Coupler Co., Pittsburg, Pa., $25,000; G. P. Krauth, Henry McCoy and Edward M. Grove. Sanitary Construction Co., Chicago, Ill., $300,000; J. B. Allen, H. N. Mann and F. S. E. Gunnell. Arkansas Weight Power Pump Co., Little Rock, Ark., $60,000; A. D. Thomas, Chas. E. Rice and G. E. Cunningham.

CURRENT PRICE LIST.

RAILS.—New York: $30 at Eastern mills, $30.75 at tidewater; old rails, $20 for iron and $14 to $15 for steel; girder rails, $40. Pittsburg: $30; old rails, $21 for iron and $15.50 to $16.50 for steel. Chicago: $31.50 to $32; old rails, $19 for iron and $14.50 to $15.50 for steel.

TRACK MATERIALS.—New York: steel angle bars, 1.85 to 1.9 cts.; spikes, 2.1 cts.; track bolts, 2.75 with square and 2.85 with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.8 cts for iron and 1.8 to 1.9 cts. for steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago; splice bars, 1.7 to 1.72 cts. for iron and steel; spikes, 2.1 to 2.15 cts.; track bolts, 2.55 cts. with square and 2.65 cts, with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 47½ per cent. on black and galvanized butt-welded; 67½ and 55 per cent. on black and galvanized lap-welded. Casing 55 per cent.

FOUNDRY PIG IRON.—New York: $14 to $16. Pittsburg: $14 to $15. Chicago: $13.50 to $15.

LEAD.—New York: 4.27 to 4.32 cts. Chicago: 4.15 to 4.17 cts. St. Louis: 4.1 to 4.15 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.3 to 2.45 cts.; channels, 2.25 to 2.5 cts.; angles, 1.9 to 2.1 cts.; tees, 2.4 to 2.75 cts.; sheared iron plates, 1.85 to 2.25 cts.; steel plates, 1.85 to 1.95 cts. for tank, 2.05 to 2.25 cts. for shell, 2.35 to 2.65 for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 2 to 2.1 cts.; channels, 2 to 2.1 cts.; angles, 1.85 to 1.9 cts.; tees, 2.5 cts.; universal iron mill plates, 1.87 to 1.95 cts.; sheared steel bridge plates, 1.95 to 2 cts.; refined iron and steel bars, 1.75 cts.; steel plates, 1.9 cts. for tank, 2 to 2.1 cts. for shell, 2.15 to 2.25 cts. for flange, 3.5 to 4 cts. for firebox. Chicago: beams, 2.1 to 2.15 cts. for standard, 2.57 cts. for small, and 2.7 cts. for 20-in.; channels, 2.1 to 2.15 cts.; angles, 1.85 to 1.9 cts.; tees, 2.4 cts.; universal plates, 2 cts.; sheared steel plates, 1.95 cts.; steel plates, 2.3 to 2.4 cts. for tank, 2.6 to 2.75 cts. for shell, 2.9 to 3 cts. for flange.

NOTICE TO CONTRACTORS.—SEWERS.

Sealed proposals for the construction of sewers and appurtenances in Clark, Forest, Prospect, North Main and two connecting streets, also in George, Alvord and Pearl Sts.; also Outfall sewer, will be received by the Warden and Burgesses of the Borough of Torrington, Conn., until 2 o'clock p. m. of the 25th day of May, 1892, at which hour the bids will be publicly opened and read.

Each proposal shall be signed by the bidder, and accompanied by a certified check for $500, payable to the order of the Borough of Torrington, as a guarantee that the successful bidder will sign the contract within the specified time.

The person or persons to whom the contract may be awarded will be required to appear with the sureties offered by him or them, and execute the contract within five days from the date of the award, and in case of failure or neglect so to do he or they will be considered to have abandoned it, and, as in default to the Borough of Torrington.

The proposals must be made upon blank forms furnished by the Borough.

The form of agreement, specifications and all information may be obtained at the office of the Borough Clerk.

The engineer's approximate estimate of labor and materials, by which the bids will be compared, is as follows, trenching and laying complete:

800 lin. ft. of 15-in. vitrified pipe sewer.
1,616 " " 12-in. " " "
8,819 " " 8-in. " " "

Furnishing materials and building complete 52 manholes; the Borough to furnish iron work.

The right to reject any or all bids is reserved, if deemed for the interest of the borough.

WILLIAM H. DAYTON,
NATHAN A. TUTTLE,
BURR LYON,
Sewer Committee.

W. G. SMITH, Engineer. 20-1t

PROPOSALS FOR STONE FOR WHARF and Jetty.—U. S. Engineer Office, 537 Congress St., Portland, Me., April 30, 1892. Sealed proposals, in triplicate, for completing a stone wharf, and depositing stone at the mouth of Kennebunk River, Maine, will be received at this office until 3 p. m. on Monday, May 23, 1892. The attention of bidders is invited to the acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, p. 332, and Vol. 24, p. 414, Statutes-at-Large. For specifications, forms of bid, and other information, apply at this office. PETER C. HAINS, Lieut. Colonel of Engineers. 20-2t